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1925.

VICTORIA

DEPARTMENT OF MINES.

NOV 15 1926

RECORDS

OF THE

GEOLOGICAL SURVEY OF VICTORIA

(W. BARAGWANATH, Director.)

Vol. IV., Part 4.

ISSUED BY

A. H. MERRIN, M.C.E., SECRETARY FOR MINES, UNDER THE AUTHORITY OF THE HON. G. L. GOUDIE, M.P., MINISTER OF MINES.

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NIL DESPERANDUM REEF, WEDDERBURN.

By H. S. Whitelaw.

The Nil Desperandum is the easternmost of the auriferous reefs in the Ordovician outcrop known as the Wedderburn Gold-field. Its persistency in strike—practically north and south—is obvious, but its continuity in depth has yet to be proved. Over its known length of 3 miles, only a few shallow shafts have been sunk. Those inspected within lease No. 6085 are between The Gulch and Devil's Gully, about 2½ miles south-south-westerly from Korong Vale, and 4½ miles north-east of Wedderburn township. Hereabouts the formation is seen to be two quartz veins associated with a west-dipping back or fault which is probably the main reef channel. The western of the two makes, 2 feet to 3 feet wide, is known as the Buck Reef, the smaller eastern one, more spur-like in appearance, and more nearly allied to the back, is from 3 inches to 6 inches wide, and gives better dish prospects than the other.

The lease-holders (Wilkinson and Napier), who have local knowledge, were struck with the fact that the gullies—Devil's, Lamplighter's, Sam's, and Mother Brown's—as shown by old-time operations were auriferous below, that is, easterly from, but not above, where the Nil Desperandum line crosses the alluvial. That fact is significant and leads one to the conclusion that that portion of the line which pre-existed above the surface was auriferous. Subsequent operations have demonstrated that gold is still in the surface stone. Future operations will determine whether it lives below.

After traversing the exposed length of the line, I formed the opinion that in pegging the area which they now hold, the lease-holders selected the best site for the further testing of the channel.

[2.12.21.]

Since a previous visit to the Nil Desperandum reef, an underlie shaft has been sunk on the pitch (39° south) of some small veins to a depth of 30 feet at the head of Mother Brown's Gully. The plan and section which accompany this report show the work done by present and earlier lease-holders. The original party sank three shafts, the last and deepest being the west, which reached about 40 feet. This was sunk to cut the downward continuation of ore bodies that had proved very rich to a depth of 27 feet in the east shaft, 20 feet distant. Records of yields from these workings are not available, but Mr. Gibson, of Wedderburn, who was employed in the old stopes, informs me that from small quantities of stone broken yields of 27 ozs. and 24 ozs. per ton were won. So coarse and rich were the specimens, he states, that police protection was enlisted in their transit from the mine to the bank.

The conditions surrounding the deposition of the ore are not clear from the little that can be seen in the accessible workings, but the descriptions given by Mr. Gibson and Mr. Forest (an original shareholder) lead one to believe that the veins are of the indicator type, the main producer being a "thin greasy black seam" which, as a carbonaceous band, forms the western leader in the shaft now being sunk by Mr. Wilkinson at 50 feet south of the old shafts. By the pioneers, this was followed southwards for a length of 27 feet from the eastern, and 22 feet from the western shaft. Gold, it is stated, was left in the face of the level from the former. The drive from the latter passed from the indicator stone into a massive white barren reef.

These old workings are now inaccessible. The east shaft is water-logged; the west is dry, but contains several feet of mullock fallen from the surface. Since to repair the latter would not be a costly matter, I recommend that it be put in order preparatory to a further inspection necessary to determine which of the two proposals should be put into effect, viz., the deepening of the shaft, or the driving of an adit along the reef from a gully on the southern fall to Kiorong Creek.

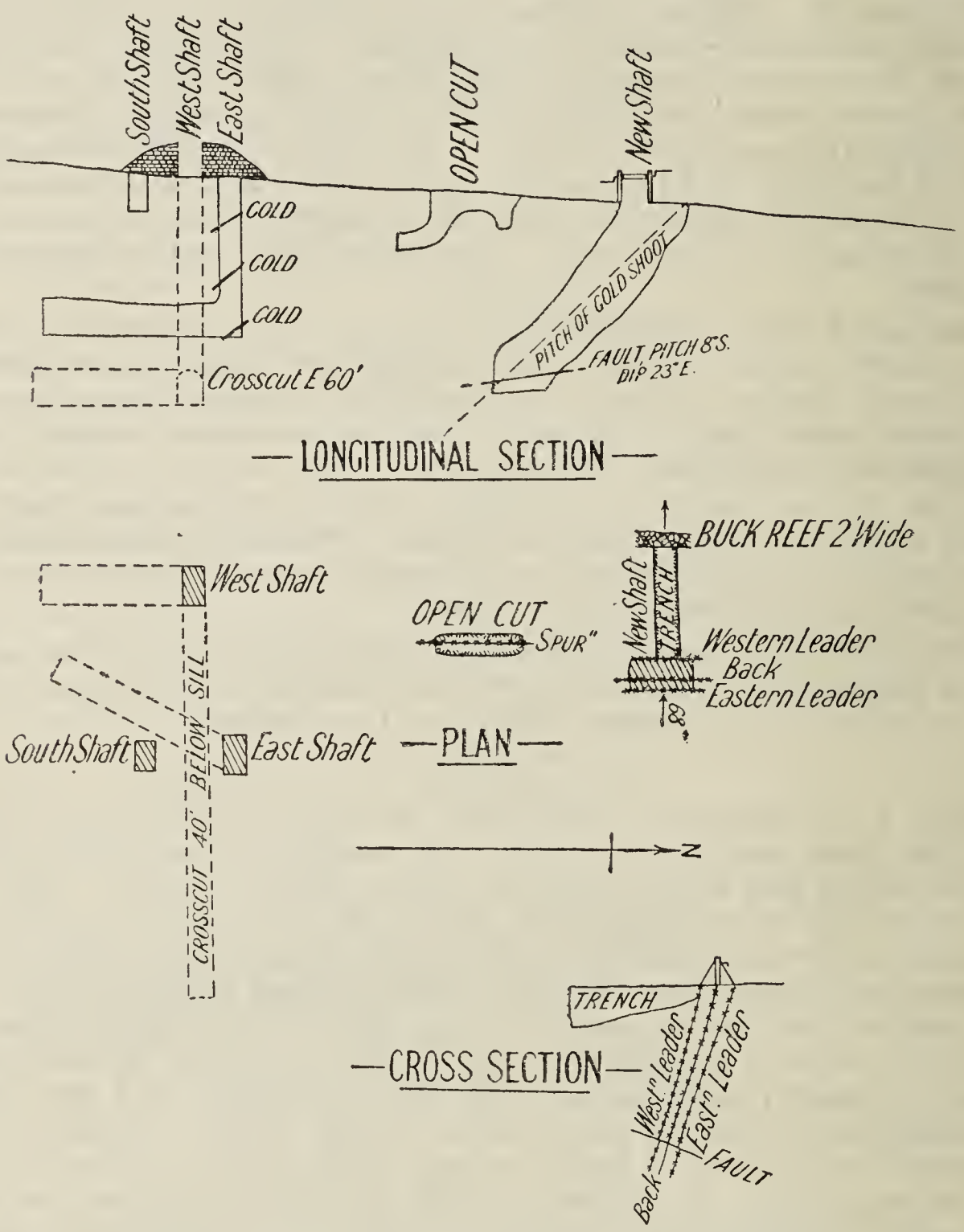


Fig. 97. Nil Desperandum Workings, Wedderburn.
Scale : 40 feet to 1 inch.

The present proprietors have broken from the new shaft rather more than a load of ore which dish washings indicate will pay to crush. It is scarcely likely, however, that it will be deemed worth while to cart the material to the Government Battery at Wedderburn, over 4 miles distant by road.

All things considered, those concerned in the future of the property will be well-advised to give further attention to the southern half of the lease

[6.5.22.]

BALACLAVA HILL MINE, WHROO, NEAR RUSHWORTH.

By W. Baragwanath.

The Balaclava Hill mine is situated near the north-eastern corner of the surveyed township of Whroo, now comprising a half-a-dozen houses, but in the sixties and seventies of last century, a flourishing township.

The mine is located on the western slope of Balaclava Hill, on the summit of which an extensive open cut marks the site of operations in the early mining days, and from which gold to the value of "more than £150,000 worth"[1] was extracted. An examination of the open cut, together with the report cited above, shows that the Balaclava reef forms the main eastern side of the cutting, and that the excavation was made in strata intersected by numerous spurs and reefs forming a stockwerke. These veins do not appear to have been auriferous to the east of the Balaclava reef, which strikes N. 15° E. to N. 20° E., and dips west at 65° to 75°, but is irregular both in strike and dip; an east-dipping vein showing at a depth of 50 feet from the surface in the south end of the cut carries the Balaclava reef to the east, making the stope at 100 feet below the outcrop practically vertically below the outcrop. The open cut has a depth of 80 feet at the deepest point and was worked from a tunnel, the entrance of which lies to the south-west. Many spurs and veins show along the western side of the cut and these, I was informed by the manager, Mr. Schrum, carry gold; but it would appear probable that enriched portions mentioned by Nicholas as occurring at intersections proved the more auriferous and were sought after by the earlier miners. Near the northern end of the cut the Exhibition and the Mary reefs are stoped; these strike more nearly east and west from 85°-120°. The strata throughout have a strike of N. 75° E., and consist of Silurian slate and sandstone, the beds which carry the auriferous quartz spurs being softer than those which occur at either end of the cutting and which carry fewer quartz spurs.

The strata are acutely folded. An anticline shows to the east of the shaft and on the eastern side of the cut; the adjacent syncline to the south is ill-defined, but the prevailing dip is northerly at 70° to vertical.

The main shaft is sunk to a depth of over 400 feet, with levels opened at 90 feet, 188 feet, 305 feet, 400 feet, and 410 feet, the latter being under water at time of survey.

In the underground workings, the whole of the accessible portion of which was surveyed, features similar to those exposed on the surface occur; but it appears probable that there were more extensive workings than those now accessible, since from a cursory inspection of the place, a difficulty arises in correlating the Balaclava reef of the surface outcrop with that driven on at the 305-feet level, to the east of which the line of reef should lie.

The 90-feet level was not accessible, and workings shown on the plan were taken from a survey by the former manager.

At the 188-feet level the chief workings are confined to a width of 60 feet east of the shaft. In the northern end at 80 feet north of the shaft an east-west lode dipping 45° N. is driven on for a length of 50 feet. No stoping is available in this direction.

---

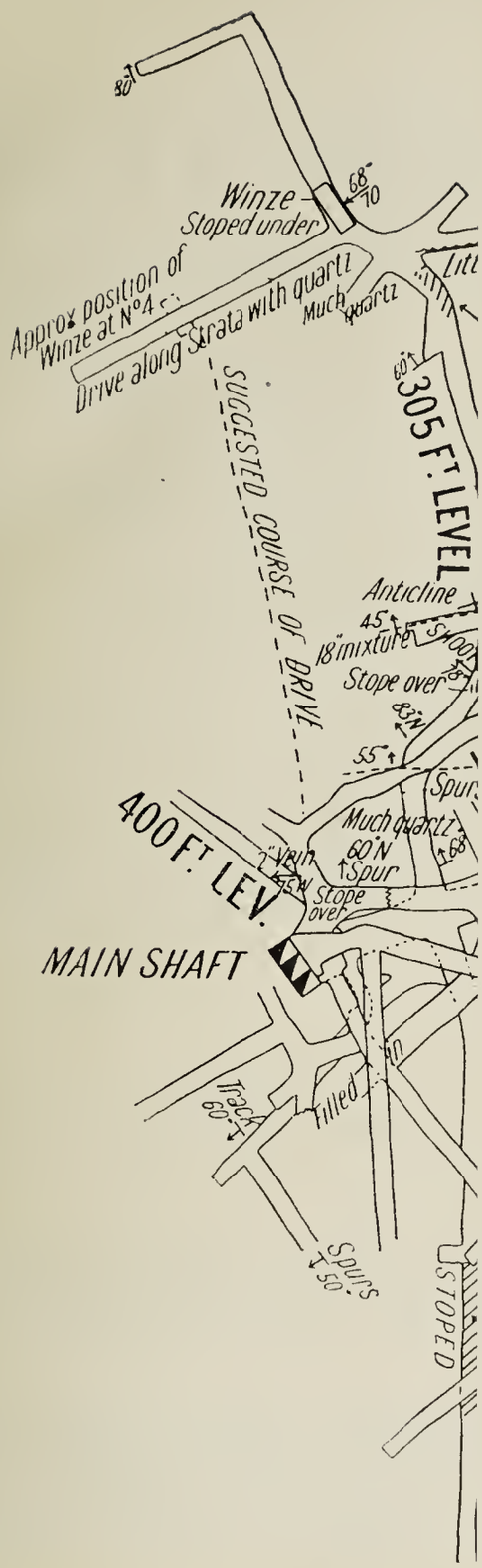
[1] Nicholas, p. 165. Prog. Rept. Geol. Surv. Vic. No. 5, 1878.

East of the shaft, stopes on small east-west veins dipping north are to be seen. At 20 feet from the shaft, further stoping on similar veins extends for a distance of 40 feet along the strike of the beds. At from 60 feet to 130 feet southerly there are stopes above and below, and these appear to be on the same auriferous belt of strata as those in the central portion of the main cut. How far easterly they extend could not be ascertained, but they are apparently extensive—one open stope comprising what is known as "the Tay bridge" being a large chasm with no means of measuring available. The south drive to 170 feet from the shaft carries numerous spurs outside the worked area, but these do not appear to have been profitable. At the south face a winze connects with the underhand stope.

No. 3 level, at 305 feet below surface, shows spurs in the strata. The main east drive (along the strata) is out 75 feet from the shaft, and at a point 3 feet from the shaft levels north and south are driven. In the north level at 45 feet a rise connects to No. 2 level east from the shaft. At 140 feet north an east-west vein (probably the same as driven on at the north end of No. 2 level) is driven on and in part stoped near the intersection of a track striking north-east. At this point a winze is sunk to a depth of 70 feet on a lode reputed to carry 15 dwt. of gold to the ton. The winze has a westerly underlie of 68°, and has been stoped on the southern side.

Southerly from the drive from the shaft overhead stopes are visible between 70 feet and 100 feet. At 140 feet a drive on the strata N. 75° E. is put through to a rise which connects to the open cut and in all probability to the Tay bridge stopes, but it is in solid ground throughout at No. 3 level with no signs of quartz. At 175 feet south the drive follows a well-defined lode which dips west from 45° to 70°, and the shoot of quartz extends for 100 feet. This lode lies 170 feet to the west of the line of outcrops of the Balaclava reef, and the underlie would have to alter considerably below the surface stopes to enable the outcrop to be correlated with this formation. At 250 feet south in the main level a drive south-west appears to pick up the faulted portion of the lode followed in the main drive, and there is a stope of 20 feet in length on a lode dipping 40° to 45° W. with a strike of 355°. A second fault displaces this lode by 15 feet along the strike of the strata and another stope 15 feet in length is met with. Below this a winze is sunk to a depth of 25 feet or 30 feet dipping west.

At No. 4 level, 400 feet below the surface, a drive at a bearing of 120° is put in 100 feet; a dam closes the eastern portion of the drive. At 25 feet from the shaft a level is driven 60 feet to the south-west, cutting a lode-track with a strike of 355°; this was considered to be the continuation of the track driven on south at No. 3 level, but which has a strike of N. 25° E. A drive of 30 feet along this track shows that it has a westerly dip, and if this drive is continued on the same strike for 50 feet from the face it will be vertically under No. 3 level. To cut this track a drive north-westerly was started at 25 feet east of the shaft and is now in 60 feet. A further distance of 60 feet will be required before the line of the track will be intersected, and as the objective of the company was to get below the winze in the north level at No. 3, I advised the manager to discontinue this drive and to open out at 35 feet back from the face on a track which has a strike of N. 20° E., and on which the level can be put in so as to reach a point at No. 4 level where the inclination of the winze suggests the likelihood of the reef being located.


Winze
Stoped under
68°
70
Approx position of
Winze at N°4
Drive along strata with quartz
Much quartz
SUGGESTED COURSE OF DRIVE
305 Ft. LEVEL
Anticline
45°
18" mixture
Stope over
85°N
55°
Much quartz
60°N
Spur
Vein
Stope over
400 Ft. LEV.
MAIN SHAFT
Track
60°
Filled in
Spurs
50°
STOPED

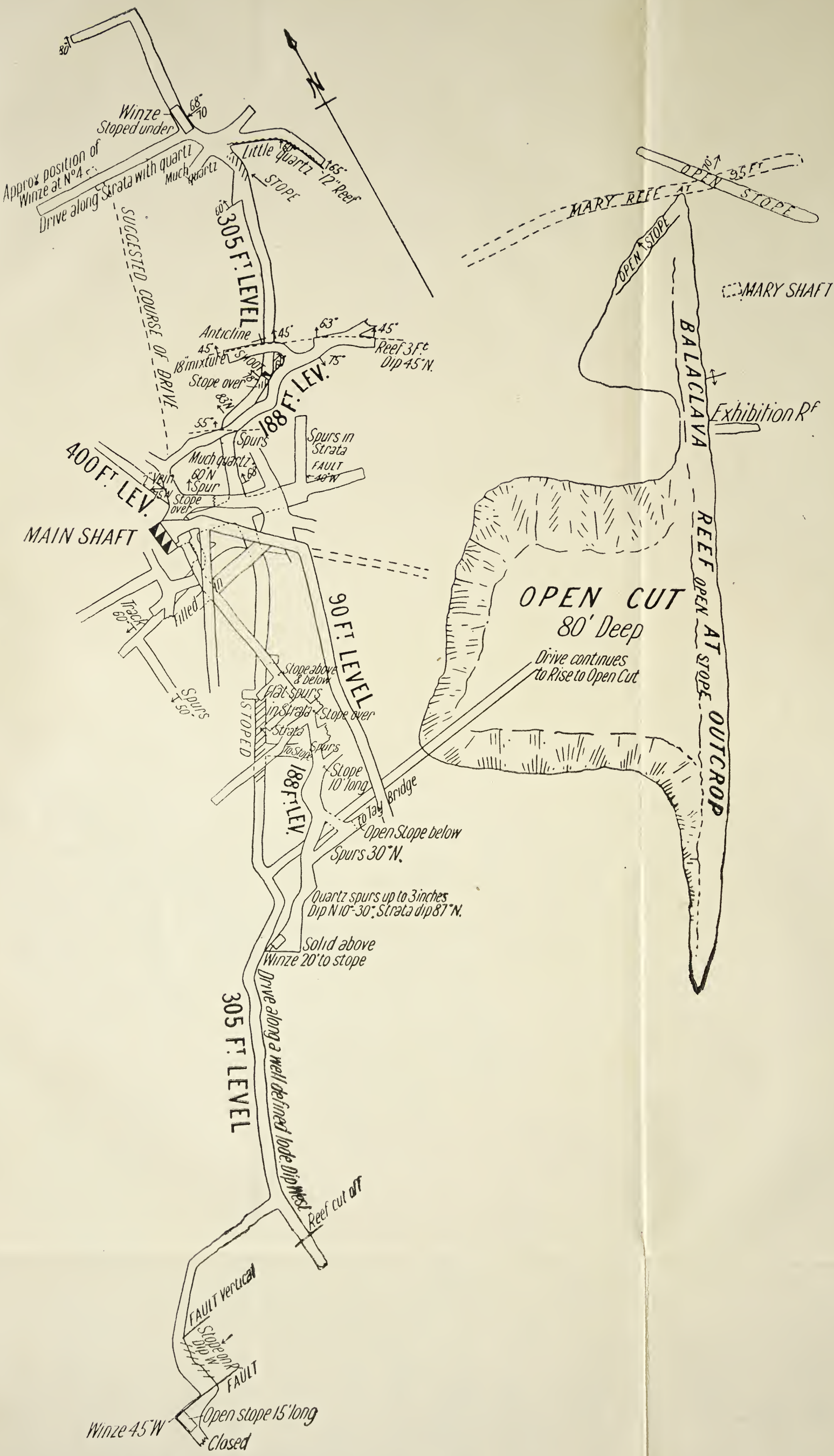


Fig. 98. Balaclava Hill Mine, Whroo. Plan. Scale: 60 feet to 1 inch.

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[To face p. 332.

After viewing the extensive open-cut workings, the underground workings reveal very little in the way of defined lodes. Quartz occurs, but is irregular in size, distribution, and, apparently, in gold values.

Before the company thinks of deeper sinking, it is advisable to prospect further at the 400-feet level, and for this purpose I would suggest—

(*a*) Continue the drive N. 20° E. from a point 30 feet from the east drive from shaft for a distance of 130 feet where a connexion can be made with winze from No. 3 level.

(*b*) Continue south level on the track and endeavour to locate a track striking about N. 20° E. which should be found at, say, 40 feet from the south-westerly drive; a rise could be put up to connect with No. 3 level under the stoped area and would prove if the values continue down.

Both these works suggest themselves, as they will be located in the same strata in which gold was found near the surface. If auriferous quartz formations of payable size exist, the prospecting may prove remunerative, but so far as the evidence available goes, I am of opinion that many of the quartz spurs worked on the surface were only worked on account of the ease of handling and the cheap labour available.

[9.8.20.]

ANNAND'S REWARD REEF, SANDY CREEK, NEAR MALDON.

By A. M. Howitt.

Annand's Reward reef is near Sandy Creek in allotment 1 of C[1] (J. Munro), parish of Tarrengower, and close to the southern boundary of the parish of Maldon. It is about 5 miles south of Maldon township.

The reef was found under several feet of alluvial sands, clays and gravels, and the first work done on the reef was on the south side of the gully where two makes were mined by Elliott and party, and a syndicate, who let a tribute to Annand and party some years ago. Annand Bros. and Knight now have a prospecting claim of 600 feet along the line of reef, and early in the year (1919) they were mining payable quartz (No. 1 make), which as followed north nearly rested on the present very rich saddle-shaped (No. 2) make. (See Fig. 99.)

Quarter Sheet No. 14 S.W. (Maldon-Tarrengower) by H. Ulrich and H. Brown (1865) shows in detail the geology of the country at and adjacent to Annand's Reward reef. The granite is about $\frac{3}{4}$ mile north of the Reward mine, but there is much Lower Ordovician country southwards. Adjacent to Annand's Reward reef the geological formations are recent clays, sands, and gravels occurring in the gullies, and Lower Ordovician sandstones and slates, which have been altered to schists and quartzites by contact metamorphism from the granite mass. An elvan dyke intrusion occurs close to the Big reef north-east of Annand's reef.

The soft schists and narrow altered sandstone beds are in places red in colour from deposition of iron oxide and show much spotting by secondary minerals. This red colouration is very prominent in the beds around Annand's Reward reef channel.

The strata at Annand's Reward claim are crushed and much altered close to the quartz occurrences, which makes it difficult to see their association. The quartz is iron-stained, vitreous, and sugary, gold showing both in the solid quartz and in small vughs. Coarse specks are now and then seen, but there is much fine gold, which is evenly distributed in the quartz, accounting for the high values in the tailings.

Fig. 99. Plan and sections of Annand's Reward Mine.
Scale : 120 feet to 1 inch.

As the sketch plan shows, there are four separate auriferous quartz makes in the claim.

(1) The South (or tribute) make strikes N. 60° W. and dips 50° south-west. It was stoped for about 70 feet long by 20 feet on its dip, and was up to 2 feet wide with fairly good walls. It is stated that 140 tons of quartz mined here averaged 1 oz. of gold per ton, some yielding 2 oz. per ton. There may be a corresponding eastern make to this reef, but so far, it has not been seen.

(2) Elliott's make is north of the South make, there being about 15 feet or so of a blank between them. It strikes about N. 25° W. and dips 50° westerly. An average yield of 1 oz. to the ton is reported from about 100 tons of quartz.

(3) Annand's Reward No. 1 make was picked up north of and below Elliott's make; it was saddle-shaped with massive quartz veins forming a vertical elongation upwards. On its west leg there is low grade quartz from 8 feet to 4 feet wide. On its east leg the quartz was richer and up to 4 feet wide, and averaging 1 oz. to the ton. Quartz 2 feet wide now shows going underfoot to the east. The cap has been followed for 23 feet on a south pitch from near horizontal to 12°.

(4) Annand's Reward No. 2 make lies under the No. 1 make (see longitudinal section) and is more like a saddle reef than anything else seen in the mine. The transverse section shows a face opposite the hauling (28 feet) shaft, where the east and west legs dip 30° and 40° respectively. The cap has been up to 5 feet thick, but going north it pinches to under 2 feet, which width it is in the north shaft. The cap and west leg are stated to be very rich, and the east leg highly payable. The cap pitches 12° south, and on its gradual rise northwards should reach the surface in this claim.

[22.9.1919.]

Annand's Reward reef continues to open up well, and the new main shaft (41 feet) cut 4 feet of gold-bearing quartz 2 feet east of the shaft. This quartz rolled slightly over just above the cross-cut, and has been stoped out on an angle of 55° up to the rich shoot on the cap at about 28 feet deep. Portion of the quartz taken out on the cap, and sent to the battery, has been up to 8 feet wide. Ten feet north from the cross-cut the reef is somewhat spurry, and a small cross fault displaced the reef south for a few feet, below which the reef continues down and shows about 2 feet of gold-bearing quartz going underfoot south-westerly. The rich shoot of quartz has followed a south-westerly pitch downwards from the cap of the reef.

[14.2.1920.]

The shoot of gold in Annand's Reward mine has been followed 20 feet south on 3-oz. stone; then the quartz became spurry and made a slight bend south-westerly, some east-dipping quartz veins making into the west leg. These spurs yielded 27 dwt. to the ton.

Below the 40-feet level the west leg has been stoped to the 56-feet level, the west leg becomes spurry and appears to cut out on an east-dipping head under which green strata replace the red strata which had been commonly associated with the reef throughout the workings. In the north drive at the 56-feet level the west leg became spurry and carried rich quartz yielding 27 dwt. and up to 4 oz. to the ton. This portion of the leg and spurs was stoped out for a length of 60 feet north, forming a pipe-like shoot, 5 feet by 5 feet, pitching 30° south-easterly and joining the main shoot at the 56-feet level (Fig. 99). In the north end the west leg is still going down 1 foot wide, and will be further prospected here.

70-*feet Level.*—At the 70-feet level a cross-cut west 20 feet passed through dark green strata with two small west-dipping veins of quartz, but no definite bedding could be seen here.

A cross-cut east 49 feet passed through dark green strata and at 12 feet beds dipping vertical to west slightly (Fig. 99, Transverse Section). At 20 feet and 32 feet small west-dipping quartz veins were cut, and

at 47 feet some quartzite and a well-defined 2 feet bed of coarse sandstone dipping 40° east. A rise easterly put up 27 feet at an angle of 33° cut the east leg of Annand's reef, here somewhat spurry over a width of 2 feet, with no prospects of gold.

It would now appear that Annand's reef is a saddle, from the evidence of the anticlinal fold in the 70-feet cross-cut from the main shaft, and other folding adjacent to the reef going north.

A small 20-feet shaft, 70 feet northerly from the blacksmith shaft, shows west-dipping strata at 6 feet in the east cross-cut at 20 feet deep, and 1 foot of quartz nearly vertical at 16 feet. This quartz may be a continuation of the main Annand's (No. 2) reef. Further work is in progress to the south of Elliott's shoot, and here a quartz formation worth 2 dwt. of gold to the ton has been cut at a depth of 90 feet.

Date.	Battery.		Tailings. Gold Won.	
	Ore Crushed.	Gold Won.		
	tons.	oz. dwt.	oz.	dwt.
February, 1919	37	25 10	14	16
March, 1919	29	10 10	5	16
April, 1919	24	9 0	3	15
May, 1919	28	22 10	9	16
June, 1919	26	158 0	21	8
July, 1919	21	275 10	39	3
August, 1919	12	172 8	20	0
September, 1919	24	214 7	30	10
October, 1919	33	181 13	35	0
November, 1919	36	178 5	28	10
December, 1919	24	87 8	14	10
January–June, 1920 ..	167	478 5	155	0
July–December, 1920 ..	92	134 13		
Year 1921	111	251 0	35	0
Year 1922	34	65 3	47	0

To the end of 1922, the yield from all sources is 698 tons for 2,724 oz. 6 dwt., including 460 oz. 4dwt. from tailings. The value of the gold is £12,816. The best crushing was 15 oz. per ton, and the highest yield from the tailings, 2 oz. to the ton.

[10.2.21.]

ANNAND'S NORTH AND SOUTH MINE, SANDY CREEK, NEAR MALDON

By A. M. Howitt.

This mine is in lease No. 7510, Maldon, and nearly surrounds Annand's Reward claim.

Several shafts have been sunk close to the northern boundary of the Reward claim, but they failed to locate anything of value. The No. 1 (north) shaft is 40 feet deep with a short cross-cut to the east. The No. 2 (north) shaft (56 feet further east) has been sunk to 40 feet, with a cross-cut 37 feet west, showing east-dipping beds with two $\frac{1}{4}$-inch tracks of quartz near the end and an east cross-cut 23 feet cutting east-dipping strata and a short irregular quartz make 1 foot wide at 20 feet, at which

point a winze has been sunk on it for 4 feet to where it pinched underfoot. This No. 2 (north) shaft is 15 feet higher than Annand's Reward claim north shaft.

Fig. 100. Annand's North and South Mine.
Scale: 10 chains to 1 inch.

As the sketch plan shows, there appears to be a general bearing N. 20° W. of the reef makes as a whole and their containing channel of beds. It is unlikely that this mine will cut the northern continuation of Annand's Reward rich make (No. 2), as if it does not pinch out going north, it will probably reach the surface in the Reward claim.

Adjacent to the southern boundary of the Reward claim several prospecting shafts and cross-cuts have been put in at depths of from 40 feet to 110 feet, but so far results have been disappointing.

The No. 3 (south) shaft is 60 feet deep and a west cross-cut has been put in to prospect for a body of quartz which outcrops 24 feet west of the shaft. Close to the shaft a small laminated quartz and slate bedded vein was cut in brown and red sandstones, but here the beds have proved practically barren of quartz. The dip of the beds is 50° east.

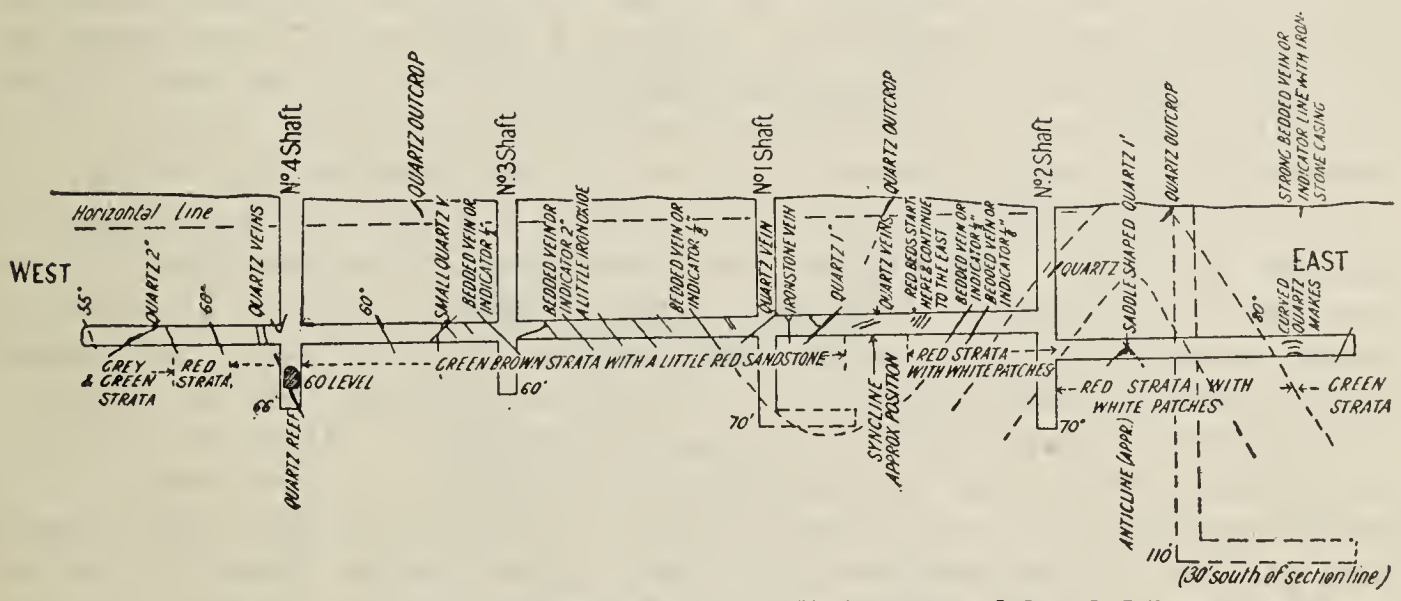

Fig. 101. Transverse section, Annand's North and South Mine.
Scale: 100 feet to 1 inch.

The east cross-cut from No. 3 (south) shaft exposes similar country to that in the west cross-cut, but a 2-in. quartz vein dipping 20° west was cut at the shaft and continued for 3 feet, where it was cut off. At 17 feet east another small bedded quartz vein dipping 50° east was cut and showed laminations of slaty material, quartz, and iron oxide, covering in all 2 inches.

At 60 feet east from the No. 3 (south) shaft a third bedded vein $\frac{1}{8}$ inch wide was cut, and at 74 feet the cross-cut connected with the No. 1 (south) shaft, a small west-dipping quartz vein showing in the shaft.

At 5 feet east of the No. 1 (south) shaft a $\frac{1}{4}$-in. ironstone vein dipping east was met, and at 12 feet a strong western-dipping quartz vein, 1 foot thick, was cut passing out in the top of the drive at 22 feet. This was valueless but the most defined body of quartz cut in the mine, and apparently the downward continuation of the quartz outcrop 35 feet east of the No. 1 (south) shaft. At 35 feet two smaller parallel quartz veins were cut, and here the brown sandstones gave place to red strata similar to those occurring at Annand's Reward claim adjacent to the payable quartz. There is a syncline here as shown on the transverse section. At 56 feet east of No. 1 (south) shaft a west-dipping bedded vein was passed through, at 66 feet another dipping 70° west, and at 82 feet the No. 2 (south) shaft was met, being 37 feet deep at the cross-cut. The bearing from No. 1 shaft to No. 3 shaft is W. 2° S., and from No. 1 shaft to No. 2 shaft E. 10° N. The surface level of these shafts is about 15 feet above that of Annand's Reward main shaft.

So far results have been disappointing, but favorable beds continue east from the No. 2 (south) shaft, where there should still be a chance of finding quartz on the trend of Annand's Reward belt which appears to bear slightly south-easterly. (See plan.) A strong bedded vein accompanied by much iron oxide outcrops about 70 feet to the east of the No. 2 (south) shaft, so an eastern cross-cut from that shaft should cut it. Six chains north of lease 7510 and on the footwall of the "Big" reef are elvan dyke outcrops.

[14.2.20.]

No. 2 (south) shaft is 70 feet deep and a cross-cut east has been put in 96 feet at 45 feet deep and a saddle-shaped barren quartz vein 1 foot wide was cut at 22 feet in red strata similar to that in Annand's Reward claim. At 62 feet strata dipping 60° east was cut, proving an anti-clinal fold. From 69 feet to 76 feet three barren curved makes of quartz 2 feet, 1 foot, and 1 foot thick were cut and lay one over the other in strata mainly coloured green but showing a little red. Even assuming that these folds are on the same axial line, it would be some depth (over 150 feet) before the Annand's Reward reef could be cut, if it continued south on its present pitch and was undisturbed by fauling.

No. 4 (south) shaft.—A new shaft (No. 4 south) has been sunk to a depth of 66 feet. At 45 feet deep cross-cuts 22 feet east and 65 feet west have been put in. The west cross-cut passed through 3 inches of quartz spurs at 12 feet; east-dipping beds at 22 feet, where red strata came in for 11 feet; and a 2-in. quartz vein dipping west at 42 feet. The cross-cut ended at 55 feet in east-dipping beds. At 60 feet deep a reef striking S. 7° E. and dipping from vertical to 40° east in the south face was cut, and drives 16 feet north and 67 feet south have been put in. Dish prospects of 5 dwt. to the ton at about 50 feet in are stated to have been obtained. This reef is spurry and up to 2 feet wide, having a good foot-wall and broken hanging wall. At 50 feet

in the south drive another quartz make dipping 75° west cuts into the main eastern-dipping reef. The strike of the reef is in line with the "Big" reef and about chains west of Annand's anticline.

No. 5 (south) shaft is 110 feet deep and has a cross-cut east 55 feet at 110 feet deep. At 92 feet a quartz body was cut but prospects were poor. The position of this No. 5 (south) shaft is about 35 feet south-east of No. 2 (south) shaft.

[10.2.21.]

In 1922, assisted by a Government grant, an old shaft in the north-western portion of the lease was cleaned out to 55 feet and cross-cuts put in east for 70 feet and west for 30 feet. This shaft was then sunk to 105 feet, and cross-cuts were put out east 117 feet and west 50 feet. The object of this work was to prospect the "Big" reef to the west and Annand's Reward line to the east, but nothing encouraging was met with.

[9.10.22.]

FLORA HILL MINE, BENDIGO.

By H. S. Whitelaw.

The Flora Hill mine is on Tyson's line of reefs 2 miles south-east of Bendigo Post Office. The bottom cross-cuts are 260 feet below the sill of shaft which is about 200 feet west of centre country. The western cross-cut reached, at about 40 feet, a west-dipping fault reef which had previously been profitably worked from a shaft about 250 feet northwards. The last leaseholder (Mr. L. Mueller) extended an old level from the main shaft to about 150 feet southwards from the

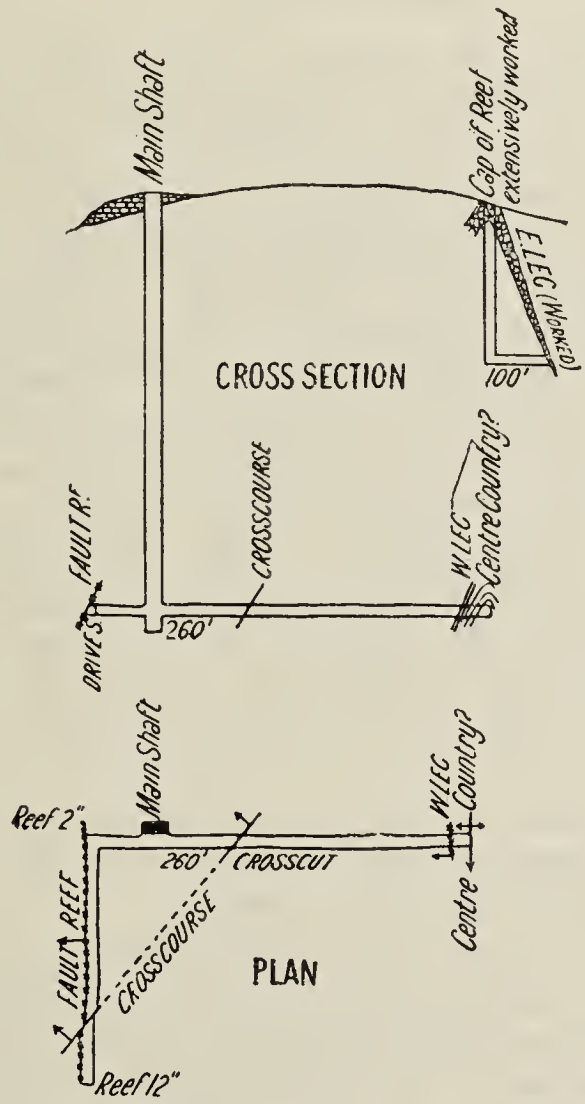

FIG. 102. Plan and section, Flora Hill Mine.
Scale: 200 feet to 1 inch.

260-ft. cross-cut on 2 inches to 12 inches of unpayable stone. At about 100 feet along this level a cross-course dipping north-west was intersected. This is also to be seen, at about 50 feet from the shaft, in the eastern cross-cut which cut a promising-looking west leg about 2 ft. 6 in. wide at about 180 feet and, judging from the rock last dumped on the mullock tip, entered centre (at about 200 feet from the shaft). It is Mr. Sheard's desire to re-open the mine and further prospect this leg by rising and driving on it. Assuming its position to be as shown on section, that is about 20 feet west of centre, the cap should be located between 20 and 30 feet above the cross-cut. If proved, by rising, to be of value a level would be driven on the leg southwards, in the direction of the pitch, and the cross-cut would be extended to the east leg.

The quartz is evenly laminated, highly mineralized and auriferous, and bears a marked resemblance to the stone which forms the productive portions of legs of saddle reefs in the central part of the field.

The shaft being open and in good repair the re-opening of the mine would not be a costly matter. That the anticline at this spot is saddle-bearing is shown by the extensive workings on the cap and east leg of a reef which outcropped at about 200 feet westward from the main shaft. From this fact, the size and inviting appearance of the west leg and the easy accessibility of the cap of the reef above the 260-feet cross-cut, the venture is one to be commended.

[24.3.21.]

SUFFOLK UNITED MINE, BENDIGO.

By J. Foster.

This mine adjoining the north of the New Moon lease is the most northern of the Bendigo Amalgamated Gold-fields Company's properties.

Three well-defined centres occur in this property, namely, the New Chum, Garden Gully, and Sheepshead anticlines. The last of these, which is represented only by a contortion of the synclinal fold in the Catherine Reef lease, has developed into a definite anticline in the western portion of this company's lease. The Garden Gully anticline is double folded into two well-defined centres in the south end of the property where the pitch is steep, but going northwards the pitch flattens, and the eastern sub-fold shows only as a minor fold or roll opposite the shaft. This eastern centre has not been extensively prospected although the New Moon Company worked several profitable saddle reefs in the north end of their lease on this centre. The original claims in the southern part of the lease worked the cap and legs of the first formation on the Garden Gully centre, known as the Undaunted reef.

The Undaunted shaft at 265 feet in depth, with a short cross-cut east of 50 feet, cut the east leg of the reef. The stone where worked averaged from 3 inches to 7 feet in width.

The Garden Gully centre shows on the surface at 315 feet west of the Suffolk shaft and was first cut at the 353-ft. level at 265 feet from the shaft, the Undaunted back being cut at 170 feet and a drive north put in to test the formation. Underlying this reef is a small formation which has also been tested in earlier days. At 225 feet a little work was done on spurs alongside the lava.

A branch cross-cut has been put out east from the south workings on the Undaunted east back, in search of the New Moon reef above 260 feet. This formation has a 12-ft. cap and a long east leg, with the west leg short and apparently developing northwards in that company's workings at 140 feet over the 260-ft. level on the Suffolk boundary.

The east leg, cap, and upper part of the west leg showed gold and one or two payable crushings were got from it in the New Moon, the bulk of the stone, however, being below payable standard. The Suffolk having passed through clean strata in traversing the centre and failing to reveal other backs than those of the Undaunted and accompanying small reef, it is assumed that the New Moon formation is identical with this small reef.

416-*ft. Level.*—The 416-ft. east cross-cut cut an outer east back at 80 feet also some spurs showing colours of gold. Between 416 feet and 353 feet a fair amount of work was done on spurs connected with the faulting of this back. These backs were cut again at 505 feet without results. At 12 feet west the Undaunted backs were again cut and were risen on and driven north on. Spurs in the rise showed gold but not sufficient to induce further prospecting. Centre shows in the end of this western cross-cut at 220 feet.

697-*ft. Level.*—The 697ft. cross-cut is out west 295 feet, centre and the lavas being cut at 190 feet. The eastern beds at about 90 feet show a slight contortion, this being the first appearance of the sub-fold on which the New Moon Company worked several saddle reefs. From 110 feet to 140 feet several small east-dipping backs were cut but no work was done on them.

797-*ft. Level.*—The 797-ft. cross-cut is out 190 feet, passing through centre country at 170 feet, the contortion of the beds in the cross-cut above having developed into a small, well-defined anticline and syncline which show at 40 feet and 55 feet respectively. A drive south was put in on this eastern centre in search of the payable reef worked to the boundary in the New Moon. That and another formation were found, but proved too small where tapped at about 200 feet from the boundary, to induce further prospecting. A little gold showed in a spur in a short centre level off the last branch cross-cut. At 142 feet from the shaft the east leg of Bowden's reef was cut carrying 3 to 6 inches of quartz, the corresponding west leg showing in the face carrying 2 inches of stone. A rise was put up on the east leg to the cap which is here pitching 8° northwards. A winze was also sunk on the west leg. Beyond this no further work has been done on Bowden's reef at this level.

896-*ft. Level.*—At the 896-ft. level at 40 feet from the shaft the eastern sub-fold has again diminished to a short roll in the eastern beds. At 97 feet Bowden's back was again carrying 3 inches of quartz and a rise was put up to test the leg. At 140 feet from the shaft the eastern leg of Scaddan's reef was cut carrying 6 inches of laminated stone; a rise was put up to the cap which is here pitching north 23°. A drive north was put in 115 feet on this leg. The south drive, at 155 feet in from the main cross-cut, was turned westerly and cut the west leg of Scaddan's reef. This drive was continued to the boundary 580 feet from the main cross-cut. Rises above this drive proved large quantities of payable stone, the reef being stoped out to the boundary. At 370 feet south a cross-cut east 50 feet was put out.

The west leg of the Moon reef was intersected at 18 feet and the east leg at 32 feet, carrying 12 inches of lava, the cap of the reef being only a short distance above the drive and pitching north. Scaddan's back was cut in the face of this cross-cut carrying 3 inches of quartz, and a drive south was put in and connected with the 943-ft level from the New Moon, the reef being stoped out to the boundary.

A drive north 60 feet from this intermediate cross-cut was driven on the east leg and lava of the Moon reef. From the end of this drive a cross-cut was put out 110 feet and cut a large body of stone which was driven north on for a short distance but proved unpayable. At 460 feet south another east cross-cut was put in 75 feet from the main level and intersected the drive south on Scaddan's back. A large tonnage of payable stone was taken from the Moon and Scaddan reefs at this end of the mine.

1004-*ft. Level.*—This cross-cut was driven to 240 feet from shaft. The eastern sub-fold at this level shows as a small contortion in the east-dipping beds. At 40 feet Bowden's back was intersected carrying $1\frac{1}{2}$ inches of quartz. At 95 feet and 118 feet respectively Scaddan's and the Moon backs were cut.

At 140 feet the Garden Gully centre was intersected pitching N.20° and carrying a small saddle reef about 2 inches thick. At 190 feet a western back corresponding to the Moon eastern back was cut and drives north 100 feet and south 120 feet put in along the reef. The Moon reef at this depth was practically all sent to the battery.

1103-*ft. Level.*—At this level Bowden's back was cut in an east cross-cut at 20 feet from the shaft carrying 6 inches of quartz. An outer back was cut in the face of this cross-cut at 45 feet. The western cross-cut at this depth was put out to a distance of 260 feet. Scaddan's back was cut at 45 feet from the shaft carrying 3 ft. 6 in. of stone and a short drive north put in. At 75 feet from the shaft the cross-cut intersected the Moon back on which drives north and south were put in revealing up to 3 feet of irregular and low grade stone. At 100 feet in the south level a cross-cut was put out east to Scaddan's back, and a level driven 30 feet on it, leaving 1 foot of stone and spurs in the face. Centre was cut at 120 feet in this cross-cut. At 220 feet the corresponding west back of the Moon reef was cut and a drive north put in 220 feet. This reef was stoped above the level and a little quartz left along the back in the stopes.

1203-*ft. Level.*—Bowden's back was intersected at 90 feet in an eastern cross-cut at this depth and carried 3 inches of stone. At 15 feet east of the shaft Scaddan's back was cut and driven on south for 200 feet and north for 120 feet. From the end of the south drive a cross-cut was put across west to the Moon back. Along Scaddan's back a good quantity of irregular quartz was found of low value.

The western cross-cut at this depth is out 185 feet. At 8 feet the Moon back was cut carrying 2 inches of quartz, but no work was done on it here. Below this level these three productive backs, i.e., Moon, Scaddan's and Bowden's, pass cut east of the shaft and have not been tested at any greater depth in this mine.

The Garden Gully anticline which consists of three small folds at this depth was cut at 125 feet and a drive was put in south on the lava without revealing payable stone.

1,362-*ft. Level.*—The cross-cut at the 1,362-ft. level is out 220 feet. At 25 feet Brown's back carrying 2 inches of stone was cut and a rise was put up 85 feet along it to an intermediate level, where drives north and south were put in. A cross-cut west from the intermediate went through centre at 40 feet which is here pitching 10° north. At 90 feet the corresponding west back of Brown's reef was cut carrying 3 inches of laminated quartz, and drives north and south were put in. The cap of this reef is about 15 feet below the 1,203-ft. level. The formations on this back were small but very profitable, some high averages being attained. Centre was passed through at 130 feet in the main cross-cut and the corresponding west back of Brown's reef carrying 3 inches of quartz at 35 feet from the western face. Brown's back was also profitably worked at 1,461-ft. level.

1,571-*ft. Level.*—The cross-cut at this level was put out 200 feet and went through the Garden Gully anticline at 80 feet from the shaft. At 70 feet west of the shaft a drive was put in 250 feet south on the cap and west leg of the Moon 1,440-ft. reef. At 130 feet in a rise was put up 45 feet to the cap, and at 205 feet south a branch cross-cut was put out east through irregular stone showing a colour or two of gold. No gold was reported in driving or rising and the stone broken was not sent to the battery. This formation is of fair dimensions and was contained between the lava and a west-dipping slide and at the main cross-cut was 15 feet in width.

A short distance east of this formation is an east-dipping back with 3 feet of quartz underlying it; a short winze was sunk in this but proved nothing payable. At 30 feet west of the shaft a drive south was put in 210 feet on an east-dipping back of no value. From the end of the drive a cross-cut was put out east 80 feet passing through two east-dipping backs.

1,669-*ft. Level.*—This cross-cut is cut 100 feet west of the shaft. At 15 feet the eastern sub-fold was cut. At 70 feet west of the shaft a drive south was put in 214 feet prospecting 2 to 5 feet of crushing material containing mineral, but no gold. From the end a rise was put through to the level above, exposing a good extent of stone. This leg was driven on for 165 feet north, opening 2 feet to 5 feet of stone and disclosing the cap overhead in the end, which is of good proportions.

In the face of the main cross-cut a back carrying 9 inches of quartz was cut.

In the main cross-cut east of the drive north and south is a spurry formation 10 feet in width.

1,768-*ft. Level.*—The west back of the next reef was cut at 133 feet west of the shaft at this level, carrying 1 inch of quartz. A drive north was put in 160 feet, showing 6 inches to 3 feet of quartz, but no gold. A rise put up 10 feet over the level showed 1 foot of mineralized quartz overhead. A second rise near the face was put up 70 feet, testing up to 3 feet of stone. No gold was seen. Centre was cut at 50 feet in this cross-cut and showed as a wide, fell defined anticline pitching 10° north.

1,868-*ft. Level.*—This level, the lowest in the mine, was under water at the time of the survey. The cross-cut went through centre at 60 feet, and a west back carrying 2 inches of quartz at 76 feet.

The amount of dividends paid was £37,035, and the calls £31,543.

The big reefs at 15 and 16 might be worth doing something on, and, perhaps, the contortion between these two levels.

[17.5.18.]

ADDENDUM BY H. S. WHITELAW.

Having, from personal observation, only a slight knowledge of the workings of the Suffolk mine, I requested my assistant, Mr. J. Foster, who was leader in sectioning the cross-cuts and assisted on the survey throughout, to give me his view of the prospects. In his report, which is forwarded herewith, he deals generally with the structure, but offers no suggestions, excepting that "The big reefs at 15 and 16 (1,571 feet and 1,669 feet respectively) might be worth doing something on, and perhaps the contortion between these levels."

In the light of the manner in which these formations have been cut up in the Moon mine, near the mutual boundary, it would appear that the Suffolk Company has given them proper notice, by the levels and rises referred to in Mr. Foster's report. Moreover, a study of the notes of Mr. Moore, who surveyed the mine, tends to confirm the opinion of the mine manager that, within easy distance of the shaft, every formation has been given a reasonable trial.

At this end of the field the adjoining New Moon has, throughout, been the pioneer, and adequate search for, and, when found, sufficient prospecting on, all formations worked in that mine have been carried out by the Suffolk Company in its mine. It is therefore pretty safe to say that if ever these mines be re-opened attention will first be given to the New Moon ground. On the result of operations there (in a report on the Moon mine forwarded herewith, two directions are indicated in which may lie possibilities of success of operations in probing new ground) will altogether depend the future of the Suffolk mine.

[17.5.18.]

ULSTER MINE, BENDIGO

By H. S. Whitelaw.

It was in the Garden Gully-Carlisle group of mines in the centre of the field that names were first assigned to prolific reefs on the Garden Gully line; and during the half-century following the earliest profitable returns from quartz veins, the objective of operations, either northward or southward, was, generally speaking, the extensions of the formations which had been stoped in these pioneer workings. The Ulster mine is southward about a mile from the Garden Gully main shaft, and, although it was slow in the race compared with its neighbours (the Londonderry and Great Southern), its record is not unenviable since, from gold recovered, £4 16s. per share has been paid in dividends on the 32,000 issued by the original company. While the shareholders were still paying calls and the shaft had reached 1,200 feet, the Great Southern Company's ground adjoining on the south had, from above that depth, yielded gold to the value of over a quarter of a million pounds, and had disbursed over £100,000 in dividends. This was towards the end of the "eighties," and just about the time

when its neighbour, the Londonderry, with its workings under the Melbourne-road (High-street) and the Bendigo Creek, had reached a depth of over 2,000 feet and had distributed nearly £30,000 in dividends.

The top payable saddle reef in the first-worked mines was Ladam's, which, in the northern portion of the Garden Gully, lease averaged 2oz. to the ton, crushings as high as 5 oz. being recorded. The legs of this reef are easily recognized in the Ulster 218-ft. cross-cut, where they have been risen on about 40 feet without reaching the saddle. There is an inch or two of stone on each, but little likelihood of a cap of any considerable size. Centre here is 65 feet west of the shaft. The east leg crosses the shaft at 279 feet below sill, at which depth a cross-cut goes out west to centre at 60 feet; its extension by less than 10 feet would have reached the east-dipping fault that, 40 feet deeper, forms the east leg of the famous Garden Gully 300-ft. reef, the cap of which in the 317-ft. (Ulster) cross-cut is 50 feet from the shaft. From this cross-cut a rise follows the fault to Ladam's west back and along its connects with 218-ft cross-cut; 70 feet up this rise, on a dip of 45°, a slidy back, probably identical with that on which the west leg of the Brown reef was worked with fair results in the Carlisle group, was intersected and driven on southward about 120 feet. The pitch of the line of intersection of fault and back is about 10° S. At about 90 feet south from the rise on the fault the back has been risen on. This rise is inaccessible about 30 feet up, but it would appear that above this height some stoping has been done.

The cap of the Garden Gully 300-ft. reef is 5 to 7 feet across the saddle, and 3 to 5 feet high. It has been driven on 76 feet south and 67 feet north. From about 30 feet south 22 loads were crushed for 1 oz. of gold. Continuing the cross-cut to 153 feet from the shaft two other east-dipping faults were intersected, and, between these, the west backs of the Brown and Ladam's reefs. Under the intersection of the fault and the Brown back at 95 to 105 feet from shaft there is a massive spurry formation carrying pyrites and black jack. This may be the neck of the Garden Gully 400-ft. reef. The north drive on it is 90 feet in length; the south 50 feet. At 35 feet in the latter direction the solid stone rose above the level, but was again entered 20 up in a rise 45 feet from cross-cut. No gold was seen.

The next plat was cut at 406 feet, where the east back of the Garden Gully 300-ft. reef shows in the shaft. The cross-cut at this depth is 125 feet in length. It intersects what are supposed to be the east and west legs of the Garden Gully 400-ft. reef and the west leg of the Brown reef and Ladam's reef. On each of the west legs there is a rise to the intersection of the two outer faults exposed in the cross-cut above. Of these only one is accessible—that on the 400-ft. reef at 50 feet from the shaft. In the cross-cut there is but 3 inches of stone; in the top of the rise 8 feet, with a tendency to enlarge upwards. On this and on the Brown back there is a winze, that on the latter connecting with the lower cross-cut. On the Brown back there are short drives, and on Ladam's a level south 26 feet and north 100 feet. In the latter, at 50 feet from cross-cut and near intersection of the back by a small west-dipping slide, the leg stone and allied spurs afford 3 feet of crush-dirt, 20 loads from it yielding 1 oz. 17 dwt. of amalgam.

The 595ft. cross-cut was put out to the east back of the Garden Gully 300-ft. reef at 140 feet east of shaft, where there is a thread of quartz.

The 694-ft. cross-cut is of interest only because it has been extended through the Paddy's Gully anticline, the next line eastward. Being now a sealed dam, the manager's reports have been referred to for the following information:—

"East backs at 50 and 65 feet (the matching west backs shown in plat and on section accompanying this report).—East back 185 feet Garden Gully 400 feet), rise 15 feet on 1 to 2 feet of quartz on this. East back at 215 feet (Garden Gully 300-ft. reef).—West back at 436 feet. East back (no stone) at 537 feet, 4 inches flucan. East back at 584 feet carrying 4 inches quartz; drove north 15 feet and rose on this. Stone 12 inches, which widened to 4 feet at 30 feet up, then split into spurs which cut out at 55 feet above cross-cut; 6 inches flucan on east back at 175 feet 2 inches quartz showing black jack and galena at 700 feet; rose on this; stone cut out at 20 feet up." The objective of work at this depth was probably the productive saddle reef worked by the Sea Company above the 643-ft. level.

At the next level (793 feet) two east-dipping faults were cut in the east cross-cut, both of which subsequent work at deeper levels proved to form the neck of saddle reefs. No work has been done at this level on the first, which is 25 feet from the shaft. On the second, which is 50 feet from the shaft, in driving 65 feet north on 2 to 3 inches of quartz, gold was seen at intervals up to 50 feet from cross-cut, but no crushing was broken. Southward a level extends over 700 feet with overhead stopes between 120 and 300 feet from cross-cut. At about 240 feet and again at about 720 feet underhand stopes have operated. Those starting at the further distance extend southward beyond the face and to an intermediate level 30 feet below. An occasional payable yield was obtained from these, but generally the stone was low grade, no profitable crushings eventuating until the reef had been opened up from the level below, which is 893 feet from the surface. Unfortunately the manager's reports of details of working this reef are not available, but it is recorded, towards the end of 1905, that "the cap stone which proved so remunerative is all worked out." The east leg has been driven on to the lease boundaries, and was found fairly uniformly payable down to 30 to 40 feet under the cap. Below that and down to the level the shoot broke up, and much of the stone remains. In a previous report it was stated "the west leg, so far as opened up, is of no value between the cap and the 992-ft. cross-cut, where it is dislocated by an east-dipping slide under which the first gold was seen. The line of intersection pitches southerly and below it to a depth of one stope under the 1,092-ft. (No. 11) level, and throughout the length of the lease the reef has been worked out. It was only a few inches wide, but is quoted as having been the richest worked in the mine. About the last work done by the old company was the driving of a level 30 feet south in search of the downward continuation of this shoot at a depth of 1,200 feet. In the face the leg is about 3 inches wide, and mineralized." That there is room for doubt as to the position of this back at the 992-ft. and 1,092-ft. levels is indicated by the recently-prepared cross-section plan which suggests the possibility of the leg on which these levels have been driven being on the west back of a lower formation (the Victory reef), the cap of which is a few feet under the floor of the 893-ft. cross-cut. The picking up of a short length of level should enable one to decide the question, and arrangements have been made for the purpose.

The Victory reef has been tested under the main cross-cut and by branch cross-cuts from the level on the east leg of the Pandora reef at 300 and 500 feet southwards, and found wanting.

The Derry reef, the next centre formation, found at 30 feet below the 1,092-ft. cross-cut has been worked out to the Londonderry boundary and for an unspecified distance south of the winze from the 1,092-ft. cross-cut. The present company, from spurs under the cap at 225 feet north, crushed 118 loads for 28 oz. Old workings restricting operations here, attention was turned to the lower parts of the east leg in which, it had been reported, good gold had been left by the old company. Over 500 feet of north level was repaired in an unsuccessful endeavour to locate this at the 1,201-ft. level. The only other work done from the cross-cut at this depth was the extension of a level south to 36 feet on the west leg of the Pandora reef at 3 feet east of the plat. The stone in the face is 6 inches wide.

At 100 feet lower the Pandora west back at 220 feet east of shaft was risen on to the cross-cut above without meeting with any quartz.

From 10 feet north of the 1,400-ft. cross-cut a rise on a west back at 110 feet east of shaft was put through to No. 13. Under a pair of east-dipping slides that cross about 15 feet up there is 4 inches of pug on the back; above there is 2 feet of pug and quartz, with no gold visible. At 160 feet from shaft there is a level south on a fault dipping 76° west. Along this at 10 feet from the cross-cut a 2-ft. spur was met with, and followed to 114 feet. A trial crushing from it yielded 2 dwt. of gold to the ton. At 100 feet from the cross-cut a winze was sunk 36 feet on 18 inches of stone. Later from the 1,500 feet level a rise connected with this. From this level to a height of 40 feet there was a full head of quartz, colours of gold showing at the intersection of west-dipping slides. This quartz at 136 feet east of shaft in the 1,500-ft. cross-cut formed the top of the cap of the 1,500-ft. reef 12 feet wide, the turnover being about 20 feet under the cross-cut. The first crushing of 62 loads from it yielded 7 oz. 17 dwt. Levels were driven north and south, taking the stone for an average width of about 5 feet under the west wall. In all, over a thousand feet of the cap has been opened up—450 feet south, 580 feet north, both faces being "all in stone but low grade." The west leg was understoped here and there along the north level, but was not payable. The east leg is small and poor. The yields from the cap were not recorded, but it is generally considered that the payable shoot was about 700 feet in length. Although the formation is saddle-shaped the indications observable in what is accessible of the workings point to its being a fault reef formed at the intersection in centre country of a strong west-dipping slide and an east back, a probability that would account for its southerly pitch, an inclination in direction contrary to that of the underlying normal saddle into which southward it probably merges.

The saddle of this lower reef is about 60 feet above the floor of the 1,600-ft. cross-cut. It had a massive cap—10 to 15 feet high and 15 to 25 feet across the saddle—in which the rich shoot was continuous for a length of over 800 feet, one face of the stopes in 20 feet of stone standing at 65 feet above an intermediate level 600 feet south of the cross-cut. In keeping with the over reef its east leg is of small dimensions, and of no value. The gold shoot on the west leg continued downwards from the saddle 50 to 65 feet.

Water is at present standing above the next plat. In consequence the manager's record has to be looked to for information as to developments below the No. 16 level. From his reports it is gathered that the shaft is 2,016 feet deep, and that there are plats at 1,700, 1,824, 1,924 and 2,005 feet with a cross-cut east from each.

At 1,700 feet the west back of the 1,600-ft. reef was cut at 60 feet east of the shaft, and risen on to 1,600 feet. On it there is 9 inches to 12 inches of poor quartz, as tested by trial crushing. Another 2-inch west back occurs at 120 feet, and on it a rise 72 feet high. From the top of the rise a cross-cut extends east 20 feet to an east back with no stone. East backs occur at 168, 210, 215, 240 and 280 feet. The cross-cut stopped at 291 feet after rising to 30 feet on the backs at 210 and 215 feet from shaft.

At 1,824 feet the cross-cut is at 158 feet out. At 134 feet along this there is a centre country winze which exposed the cap of a saddle reef between 70 and 90 feet down. The 1,924-ft. cross-cut afterwards passed through the saddle of this at about 145 feet from shaft and cut the east leg, 4 feet wide, at 154 feet. Both the cap and leg were prospected (the latter from a rise above the 2,005-ft. cross-cut), as were two small backs at 95 feet from shaft. The yields averaged $3\frac{1}{2}$ dwt. of gold per ton.

From the 2,005-ft. cross-cut and at 150 feet from shaft a centre country winze reached a depth of 152 feet, revealing small spurs between 30 and 111 feet down.

With little inducement and without the wherewithal to deepen the shaft, the company is faced with the necessity of further prospecting formations already more or less opened up in a fairly well-dissected mine. With a knowledge of the history of the pioneer companies along the line, one must be struck by the small amount of prospecting carried out on the two extraordinarily rich Garden Gully 300-ft. and 440-ft. reefs which produced great quantities of gold in the older northern mines and were payable in the adjoining leases, the Londonderry and the Great Southern. The bulk of the gold from the sale of which the Londonderry distributed £27,500 in dividends, must have come from the Garden Gully 300-ft. reef. From the same formation the Southern Company paid 5s. 3d. per share on 33,750 shares issued. In the Ulster, this reef was cut in the 317-ft. cross-cut and driven on 67 feet north and 76 feet south, and a winze was sunk a few feet on the east leg. On the 440-ft. reef there is a rise 34 feet high. In the bottom of this the stone is 2 inches wide; in the top 8 inches. The increased width is obviously due to enlargement along the strong fault which in the cross-cut and below forms the east back and above forms the neck of the 440-ft. reef. The heightening of this rise should disclose the west leg of the 300-ft. reef at its intersection by the slide. Since, however, it appears that both reefs as exposed are in a poor section, the extension of levels along them seems the best method of prospecting.

The cap of the next reef below—the Pandora—has been extracted, but the legs in their lower reaches still afford a height of stone throughout the length of the lease, the east back especially offering prospects south from the 992-ft cross-cut, 6 inches of stone showing in the face at about 70 feet in.

There is nothing tempting between this and the 1,600-ft. reef, which may have some connexion with the Garden Gully 1,550-ft. reef. It is doubtful whether it has been seen in the Londonderry, but in the Great Southern its record is a fine one. It would appear from the returns that there was not a gradual decrease in the yields as it was followed southwards, but a sudden drop at 600 feet where, in a rise of 65 feet on the west leg to the cap, payable gold in 4 feet to 20 feet of stone was reported. At 640 feet in it was poor, and in the face and a rise to 63 feet above it in 18 feet to 25 feet of stone there is no gold to be seen. Both the leg and cap at this end have a most attractive appearance, and doubtless with improved working conditions existing (the temperature and humidity are both high) the company would further prospect in this direction, knowing as it does that there is about 800 feet of ground available between the face here and that in the Great Southern. Having no air compressor it is certain there would be difficulty in obtaining and retaining hand labour. It has been suggested that this might be overcome by extending the 1,500-ft. level now in about 450 feet and connecting with the rise from 1,600 feet.* Meanwhile the northern end of the reef is being tested. The previous company suspended operations here in the vicinity of a diagonal fault at about 240 feet from the cross-cut. Up to this the cap was solid and with the west leg was payable. Beyond it the cap formerly of easy northerly inclination, according to report, took on a sharp southerly pitch, broke into spurs and became unpayable. Excepting a slight contraction in width northward the fault had little effect on the physical characters of the leg which is not dislocated. Along the whole length of the gold shoot, as opened up, the fault in its strike and dip is coincident with and forms the back of the leg. At the point of divergence it takes off towards centre country in a direction slightly east of north making an angle of about 35° with the strike of the back and dipping 60° N. The work in hand is designed to ascertain whether the fault determines the outlne of the gold shoot at this end and with that in view, so soon as the leg has regained its normal width, a rise will be put up in search of the cap.

Since taking up the running the company has driven about 60 feet, the level having reached about 300 feet north of the cross-cut. Colours of gold have been seen in driving and the leg having enlarged from 5 inches to 15 inches the prospects may be said to be distinctly encouraging.† [29.10.21.]

NEW MOON MINE, BENDIGO.

By H. S. Whitelaw.

The future of the New Moon mine was discussed with the manager towards the completion of the underground survey and very shortly before operations were suspended. The conclusion arrived at was that, at any rate above the 19 level, to which depth (1,820 feet) the workings were thoroughly examined and mapped by my staff and myself, the mine had reached the end of its tether so far as the Garden Gully anticline is concerned. The whole of the gold produced was won from saddle reefs on this line, and from spurs in eastern beds between it and the shaft—from a width, that is, of just on 300 feet. Any amount

* This is now being done. H.S.W. 20.9.24.

† Payable crushings have since been broken. H.S.W. 20.9.24.

of quartz remains in the spurry sections wherein even a colour of gold was sufficient inducement to cause the ground to be effectively prospected. All that is visible can be classed as very low grade, and, seeing that the extensions of the deposits have been tested in the adjoining mines, there would seem little likelihood of further prospecting revealing a gold shoot of any considerable dimensions.

There is stone in plenty also in the centre formations, but they, too, like the spur systems, have received what is ordinarily considered fair overhauling. Except in two cross-cuts, the anticline has been pierced at every level. Where indications seemed to justify the work (and in many places where they did not) rises and levels were put in sufficiently far to prove the makes.

A feature of the structure of the anticline is its double-folding below 500 feet. This was not recognized until the geological survey had sectioned the mine, the formations in the branch (east) fold and intervening syncline being classed as spurs, instead of which they are small compact saddle and trough reefs, and in recent years contributed the bulk of yields. The stone at the north end of a couple of them would, in ordinary surroundings, pay to remove, but, owing to their strong northerly pitch (35°-40°) along which they were under-stoped, they became unhandy to work. Their quality in the short remaining stretches between the faces and the boundary hardly warrants the driving of long levels to their extensions at greater depths.

Below the 1,538 feet level the geology of the mine has not been worked out, the lower levels being under water while I was conducting the survey. Sections of the cross-cuts and surveys of the levels, however, were made by officers of the survey. The cross section indicates that the temporary rolling-out of the double-folding coincides with the petering out of payable gold.

Between this depth and the bottom level (2,418 ft.) there are cross-cuts to and beyond, centre at vertical intervals of 100 feet, in which, as well as in a cross-cut east from No. 19 plat, there are legs and faults. On the most promising looking of these levels have been driven and rises put up. Gold was occasionally seen, but, according to the manager, nothing exposed offers inducement for further exploration.

It would seem from this that all the exposures about the anticline have had a fair trial, and plans, &c., in this office do not suggest that much chance would lie in the further prospecting of them. There are two directions, however, in which there would seem to be some hope in proving new ground. The first is below the bottom level; the second in the eastern syncline. The inducement to deepen the shaft is the probability of penetrating the Clarence "2,280-ft." reef, which, in the mine of that name, was, in places, very rich in the cap and west leg, and has been worked throughout the length of the lease. When the 2,318-ft. plat (in the Moon) exposed an east leg of a saddle, the reef was taken to be identical with the Clarence, but the steep pitch of the formation makes it improbable that such is the case. More likely is it, by a good deal, that the reef lies below the bottom of the shaft, which, being practically in centre, is well placed for the search. No cross-cutting should be required in a sink of another 200 feet.

Concerning the eastern syncline; from its known position at the surface, 50 feet east of the shaft, it should be reached in a few feet, at a shallow level, by extending the 384-ft. or 445-ft. cross-cut, and, at a depth, by extending the 1,820-ft. cross-cut. The 384-ft. cross-cut,

now out 54 feet, should, at about 110 feet from shaft, reach the syncline, at about where a couple of backs are due to trough in the vicinity of two or three faults. The 445-ft cross-cut, 85 feet in length, should, with an extension of about 40 feet, reach the same fold, but, according to section, too deep to meet the turn of the known higher-level backs.

The 1,820-ft. cross-cut, driven apparently to cut the downward continuation of the main east back (rich in some higher levels), stopped 50 feet short of its objective. It may have been seen north of the cross-cut from the face of which there is a level. I can find no record, however, of a branch cross-cut having been driven from this. In the face of the cross-cut, 235 feet from shaft, there is an east back from drives on which 333 tons of quartz yielded 25 oz. of gold. The extension of this cross-cut would pass through the main east back on its way to the syncline which, if it runs parallel, in depth, with the anticline, should be cut at 335 feet from shaft, that is, in 100 feet of cross-cutting. The leg on the main east back, after passing, on its descent, the midway point between the anticline and syncline, commences to enlarge and gives promise of forming a reef in the trough below the 1,820-ft. cross-cut. This syncline has been seen once only in the mine—at 117 feet east of the south shaft in the 300-ft. cross-cut, where a small trough reef showing the colour of gold is exposed. The reef, it is said, is of inviting appearance, but, being set in hard country, was not followed. The manager, when the mine was open, advised that it be driven on.

There is thus the fact that the syncline is saddle-bearing, and it might prove worth while to examine the fold where trough the backs that have been worked with success over the anticline.

[17.5.18.]

BENDIGO A1 COMPANY, BENDIGO.

By H. S. Whitelaw.

A recent inspection of certain levels in the New Moon and North Argus mines (now included in the Bendigo A1 Company's lease) enables me to report on work done therein since my reports of 17th May, 1918, and 14th March, 1919, were sent in. If these latter be referred to, the statements will be seen (1) that though there are remains of ore-bodies along the main and subsidiary anticlines, the reaching of them would necessitate the driving of long levels; (2) that new ground would be opened, with some chance of success in so doing, by sinking below the bottom level and by cross-cutting east to the Paddy's Gully syncline. Notice of the last two remarks was taken by the A1 Company, and a shallow-level cross-cut was extended to a trough reef of no value, and a winze was sunk south of the shaft to a depth of 145 feet, which passed through two small east legs, also of no value. The higher of these legs, there is reason to think, is on the east back of the Clarence 2,280-ft. reef, which, in the mine of that name, was rich in parts. In the A1 Company's winze it was cut, according to the manager's measurement, at 90 feet below the collar and, according to my measurement, at about 20 feet east of centre country. The saddle of this should be

about 20 feet below the cross-cut from which the winze was sunk, and, if there is a cap of workable dimensions, its upper limits should be immediately below the splintery sandstone exposed in that cross-cut. There is little encouraging in the appearance of this reef, and further prospecting of it would not be advised were it not that a similar statement would have been applied to the east leg of the 2,280-ft. reef in Clarence, which was irregular and diminutive. It so happened however, in the latter case, that the west leg was first met with. It, with the cap, was profitably worked for a length of several hundreds of feet. In the New Moon mine, these portions of the reef should be examined, either by a cross-cut from the winze at about 30 feet below the collar, or by another winze 30 to 40 feet west of the deep winze. Until that has been done, consideration of the advisability, or otherwise, of deepening the main winze will be withheld. The indications in a short cross-cut from the bottom, it may be mentioned, are favorable for sinking, the mineralized slates containing bedded quartz veins in centre at 12 feet west.

Other work carried out by the company, but not included in the scheme of operations as outlined in my previous reports, has been:—

(1) The extension of the north level, at 2,418 feet, from 127 feet to 175 feet. In the face of this, spurs are showing under an east-dipping fault, the stone on which forms the neck of a poor cap that pitched underfoot nearer the shaft. Further prospecting will be confined to cross-cutting west to test the spurs.

(2) The driving of a cross-cut 220 feet east at 1,721 feet. The object of this work was the so-called main east back, near its intersection by a west-dipping fault. This fault was not reached, but two others, eight feet apart, were passed through, and three or four backs (the main included). These latter lie between two strong faults about 70 feet apart, and the combination is such as to suggest that a strong spurry formation should exist here. One or two spurs were cut and gold was seen, but as a fracture zone it is apparently of little account. At 100 feet lower (about 70 feet below the main fault) the main east back has been driven on, north and south, and from it, and from spurs under it, a milling of 333 tons yielded 25 oz.—an average of $1\frac{1}{2}$ dwt. per ton. It is not likely that further work will be done in this section, but preparations are being made to extend the 1,821-ft. cross-cut, which is now out 235 feet, the objective being the Paddy's Gully syncline, in which, at higher levels, trough reefs have been found. This work, savouring as it does somewhat of blind stabbing, might well be preceded by a horizontal bore. It is not possible, with the data in hand, to determine the depths at which the several backs east of the main east back will trough.

(3) The extension of the 1,142-ft. main west cross-cut to and beyond the west leg of the 763-ft. reef. Nothing of value being discovered here, a branch cross-cut was driven east from the end of the north level on the main east back at 190 feet from the main cross-cut. The reason for this, probably, was the locating of the intersection of the middle back by a cross-course, which crosses the main cross-cut further west, and the level at 60 feet north of the main cross-cut. Unsuccessful again here, a north drive from the branch cross-cut was started on the middle back, 25 feet east of the main back. This is in 35 feet on three inches of bedded stone, under which a few spurs make westerly. There being some doubt as to the stretch of ground available for stoping

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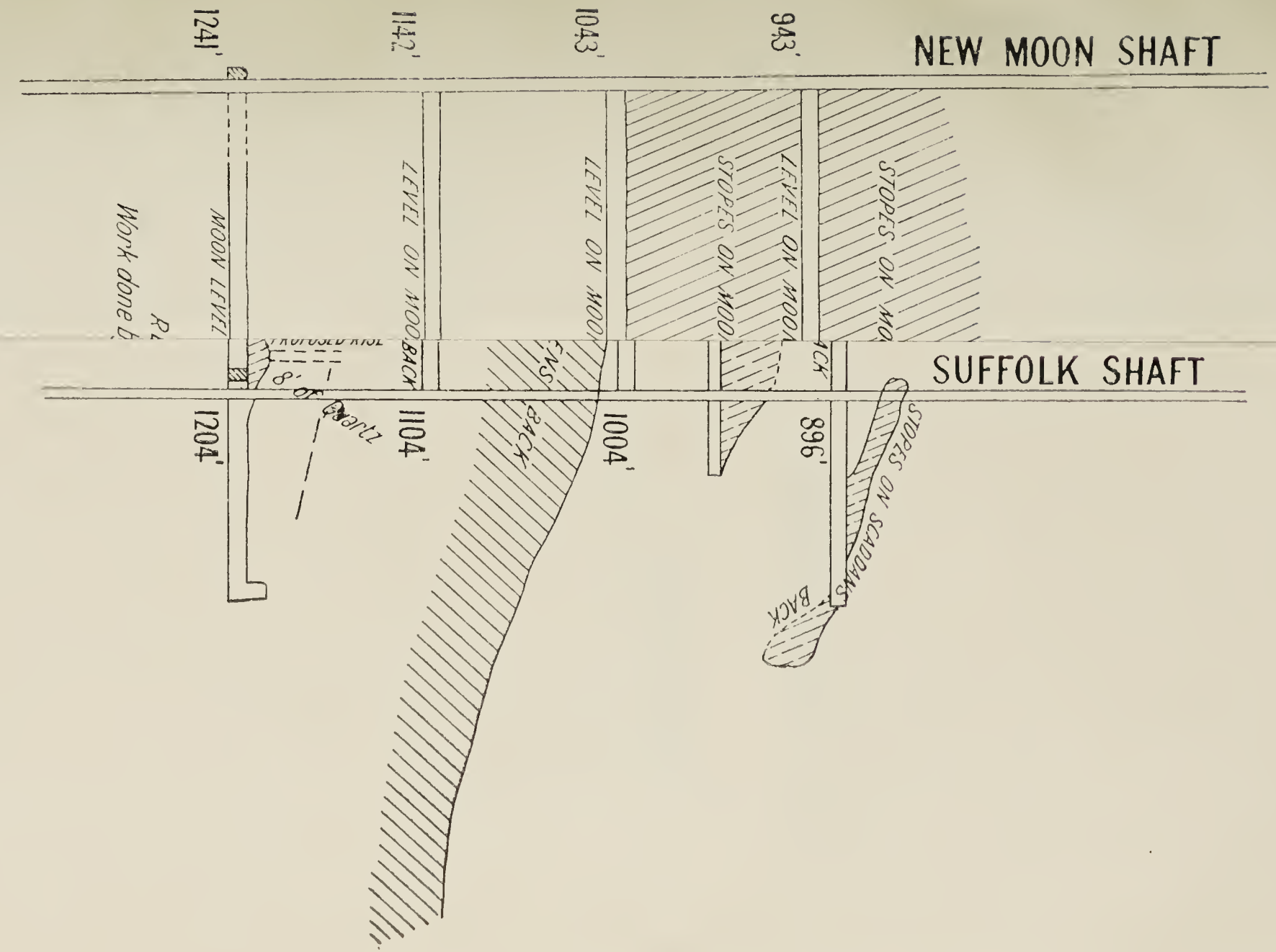
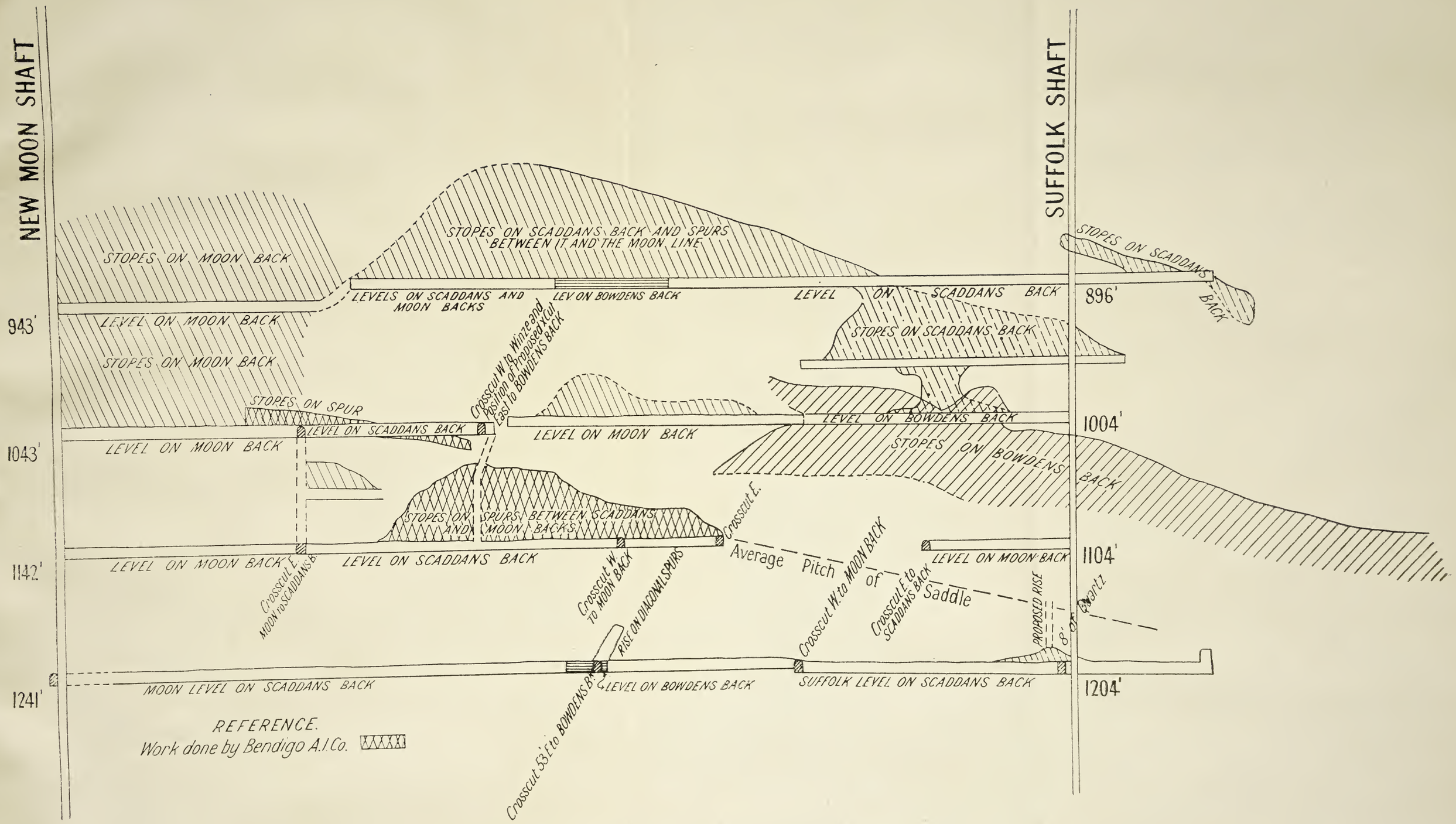

NEW MOON SHAFT
SUFFOLK SHAFT
1241'
1142'
1043'
943'
1204'
1104'
1004'
896'
LEVEL ON MOON BACK
STOPES ON MOON BACK
STOPES ON SCADDANS BACK
Work done by


NEW MOON SHAFT
SUFFOLK SHAFT
943'
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1241'
1004'
1104'
1204'
896'
STOPES ON MOON BACK
LEVEL ON MOON BACK
STOPES ON MOON BACK
STOPES ON SCADDANS BACK AND SPURS BETWEEN IT AND THE MOON LINE
LEVELS ON SCADDANS AND MOON BACKS
LEV ON BOWDENS BACK
LEVEL ON SCADDANS BACK
STOPES ON SCADDANS BACK
STOPES ON SCADDANS BACK
Crosscut W. to Winze and Position of Proposed X cut East to BOWDENS BACK
STOPES ON SPUR
LEVEL ON SCADDANS BACK
LEVEL ON MOON BACK
LEVEL ON MOON BACK
LEVEL ON BOWDENS BACK
STOPES ON BOWDENS BACK
STOPES ON AND SPURS BETWEEN SCADDANS MOON BACKS
Crosscut E.
Average Pitch of Saddle
LEVEL ON MOON BACK
LEVEL ON MOON BACK
LEVEL ON SCADDANS BACK
Crosscut E. MOON to SCADDANS B
Crosscut W. TO MOON BACK
RISE ON DIAGONAL SPURS
Crosscut W. to MOON BACK
Crosscut E. to SCADDANS BACK
PROPOSED RISE
8' of Quartz
MOON LEVEL ON SCADDANS BACK
Crosscut 53' E. to BOWDENS B.
LEVEL ON BOWDENS BACK
SUFFOLK LEVEL ON SCADDANS BACK
REFERENCE.
Work done by Bendigo A.I.Co.

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FIG. 103. Section, Bendigo A1 Mine. Scale: 120 feet to 1 inch.

ahead of the face of this drive, I attach hereto a plan of the workings as I have seen them at this and a corresponding depth in the Suffolk

FIG. 104. Plan of Suffolk United and New Moon workings
Scale : 200 feet to 1 inch.

United—the mine next north. Unless much work has since been carried out southward from the Suffolk end at No. 11 in that mine, the A1 have a clear run from the present face to, and a bit beyond, the

old boundary between the Moon and the Suffolk—a matter of 300 feet or so, and it would seem that the extension of the drive now in progress should meet with parallel deposits of quartz above the spurs and small bedded reefs worked profitably further south. North of the main cross-cut at this depth, and at the level above, the Moon cross-course unites with the main east back, the conjunction forming the lower limits of one of the New Moon most productive formations. It is the northerly extension of this that the A1 Company is seeking. The Moon Company, at 50 feet above, drove an intermediate level to a spot 30 feet ahead of the A1 Company's level at No. 12. This shows that the formation is going on, but that the values have gone out. There would seem, however, to be a length of unprospected ground ahead, in which there is room for the occurrence of another shoot.

(4) A rise on the east leg of a reef on the main fold at 250 feet west of the shaft at the 1,043-ft. level, which reached a small cap of no value at 60 feet over the cross-cut.

(5) The extension west of the main cross-cut at the same depth from 313 feet to a slide at 385 feet west of the shaft. Three feet of quartz exists between this slide and the west leg of the 763-ft. saddle reef. Gold was seen in the south drive on this, and a rise is to be put up at between 30 and 40 feet south of the cross-cut. The stone here is of favorable appearance.

(6) A little unsuccessful prospecting at the 763-ft. and 1,341-ft. levels.

North Argus.

This mine throughout has been something of a duffer. A transverse section to a depth of 1,640 feet, which may be seen at this office, shows that centre and the eastern beds have been fairly well cut up by the original company, which, restricted probably by the lease boundary in that direction, had not, below 478 feet, tested the western beds. With little else tempting, the A1 Company started off by extending the 736-ft., 835-ft., and 935-ft. cross-cuts through centre to the western back of the Moon 736-ft. reef. After several backs of no consequence had been uncovered (and one risen on 80 feet at 215 feet west of the shaft at the 935-ft. level), the 835-ft. and 935-ft. cross-cuts were discontinued. That, at 736 feet, should end at a back this week. Operations will then be confined to prospecting the South Moon spurs at 653 feet and 935 feet. At the former depth a level, the face now 30 feet south of the cross-cut, is in clean country, and above the spurry system which pitches north in slates; at the latter depth, and at about 300 feet south of the main cross-cut, stoping has just been re-started at a height of about 20 feet above the level on spurs in sandstone, the lower limits of which have been worked by the Clarence Company (south), and the South Moon (north) with good results by the latter, and fair by the former company. In the Clarence end the series was taken 10 feet wide and, so it is said, with an endeavour to feed five batteries, where two could have crushed roughly picked material, a large percentage of mullock was sent to the mill. The old method of working tends to confirm this statement, the stopes, for want of the rock that should have been used for mullocking, presenting a ragged appearance. The A1 Company is now breaking stone from the back of these old stopes, and in due course a crushing will be put through. On the day of my visit a fair sample of gold was showing. When the stopes have been put in working order,

a yield of 5 dwt. of gold per ton should be a payable return. There would appear to be some hundreds of feet in length of the upper reaches of this system southwards, in which direction a connexion with a Clarence cross-cut about 100 feet south will afford reasonably healthy working conditions.

Neangar.

The outcome of prespecting from this shaft, after it has reached a depth of between 400 and 500 feet should, I take it, be the hope of the company. Situated between the Derby anticline and the Canterbury fault, about which the Why Not Company, a few hundred feet southward, long ago, profitably worked a spurry formation, the shaft could hardly be better placed for exploring at the depth mentioned. In the mistaken idea that the ald workings east of the shaft are on an east back (they are generally referred to as being on the Canterbury back) a cross-cut at 140 feet was driven unnecessarily beyond the fault which was cut at 105 feet east of the shaft. With a dip of 60° west, this fault should cross centre at about 400 feet below surface. The shaft is now 200 feet deep.

The conclusions to which the recent inspection have led me are:—

1. That the Neangar shaft should be sunk to 450 feet.

2. That, at the New Argus mine, the 653-ft. and 935-ft. south levels should be extended, the former to the South Moon slate, the latter in the South Moon sandstone spurs.

3. That in the New Moon mine, at 2,418 feet, the cap and west leg pertaining to the east back which passed through the south winze at between 90 and 120 feet below the collar should be tested.

4. That the cap of the 2,318-ft. reef be further prospected towards the south boundary.

5. That the drive now on the way to the Suffolk ground at 1,142 feet be continued.

6. That a rise be put on the stone above the fault in the end of the 1,043-ft. cross-cut.

[21.10.19.]

Though it is not certain (the stopes are inaccessible) it seems probable that the system of spurs now being worked by the Bendigo A1 Company, between the 1,043-ft. and 1,142-ft. levels have been stoped by the original company between a point about 60 feet north of the main cross-cut, at 1,043 feet, and one in an intermediate level, a similar distance north of the rise connecting the two levels at about 200 feet north of the main cross-cuts.

The spurs occur in a much-faulted section, between what have recently been termed the " middle " and " slidy " backs, 24 feet apart, in the eastern limit of a steep-pitching eastern sub-fold of the Garden Gully anticline. The old company drove north levels a length of 200 feet from the main cross-cuts at 1,043 and 1,142 feet, and from the connecting rise at the end of the latter, put in an intermediate level north at about midway between the two. No stoping was done from 1,142 feet, but from 1,043-ft. a spurry formation between the " slidy " back, on the east, and a cross-course, on the west (both are shown on accompanying plan), was taken out up to No. 10 level, 100 feet

shallower, and above the intermediate level (according to Mr. Mining-Surveyor Clark's section), a little overhead stoping was also carried out.

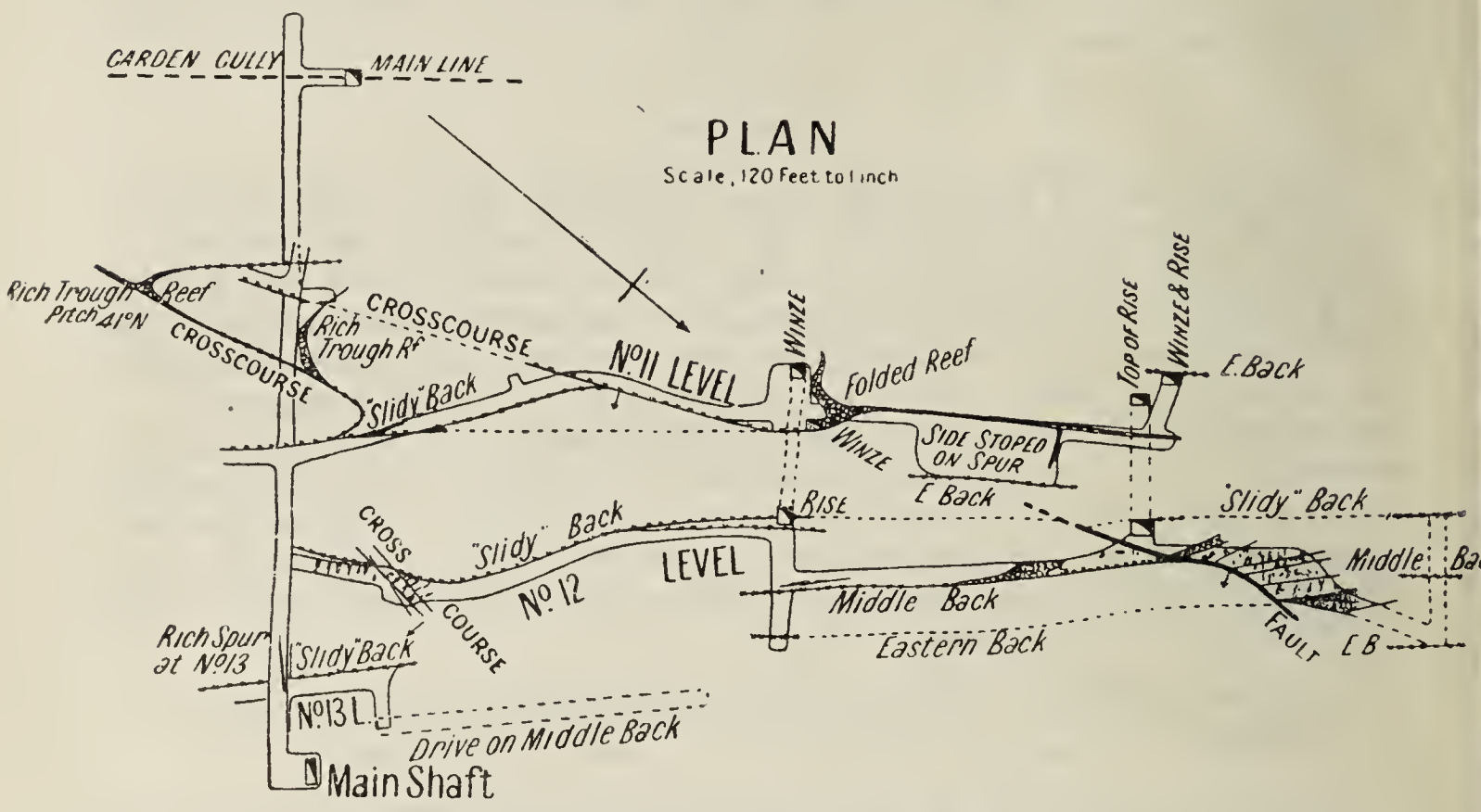


FIG. 105. Plan of the Bendigo A1 Company's workings.
Scale : 120 feet to 1 inch.

The present company is stoping above the 1,142-ft. level, and side-stoping payable spurs at the 1,043-ft. level. In all, 3,504 loads of quartz have been crushed, for 1,115½ oz. of gold, the last four crushings averaging 8 dwt. per ton, from 1,000 loads. The best crushing, one of 37 loads, which returned 49 oz., was broken from about 380 feet north of the main 1,142-ft. cross-cut, which spot appears to be about the centre of the auriferous shoot or pipe. From the fact that a rise some 40 feet south from here, and connected with a winze from the 1,043-ft. level, traversed valueless stone, and that the quartz in the face of the stopes at 410 feet north of the main cross-cut is poor, it would appear that the gold shoot is short and nearly vertical. This being so, it is evident that the future of the mine must very much depend on the result of operations northward at deeper levels.

Whether the 1,043-ft. level should be extended northward will depend on the issue of the stopes now rising from 1,142-ft., that is with regard to the main body of ore. With reference to the small north-pitching, east-dipping spur, now being operated on between 240 feet and 300 feet north of the 1,043-ft. main cross-cut, the policy should be to follow the vein on its pitch to a point opposite the connecting winze—a matter of 40 feet or so. By so doing would be ascertained the depth at which to cross-cut east from the winze.

The prospects, it may be said, just about warrant the extension northward of the 1,241-ft. (No. 13) level, say 350 feet, beyond the north face which, on the " middle " back, is now about 167 feet north of the main cross-cut. In this direction the ground is virgin, being, as it is, untested in the adjoining mine, the Suffolk United.

[16.12.20.]

The longitudinal section of the workings from the middle levels on the Moon, Scadden's and Bowden's backs between the Bendigo A1 Company's Moon and Suffolk shafts shows the gold chutes in the various reefs as worked by the old and present companies, and will prove handy for reference when proposals for the future working of the mines are being considered. The proposals put before me by, and which I have discussed with, the mine manager, Mr. Langdon, are:—

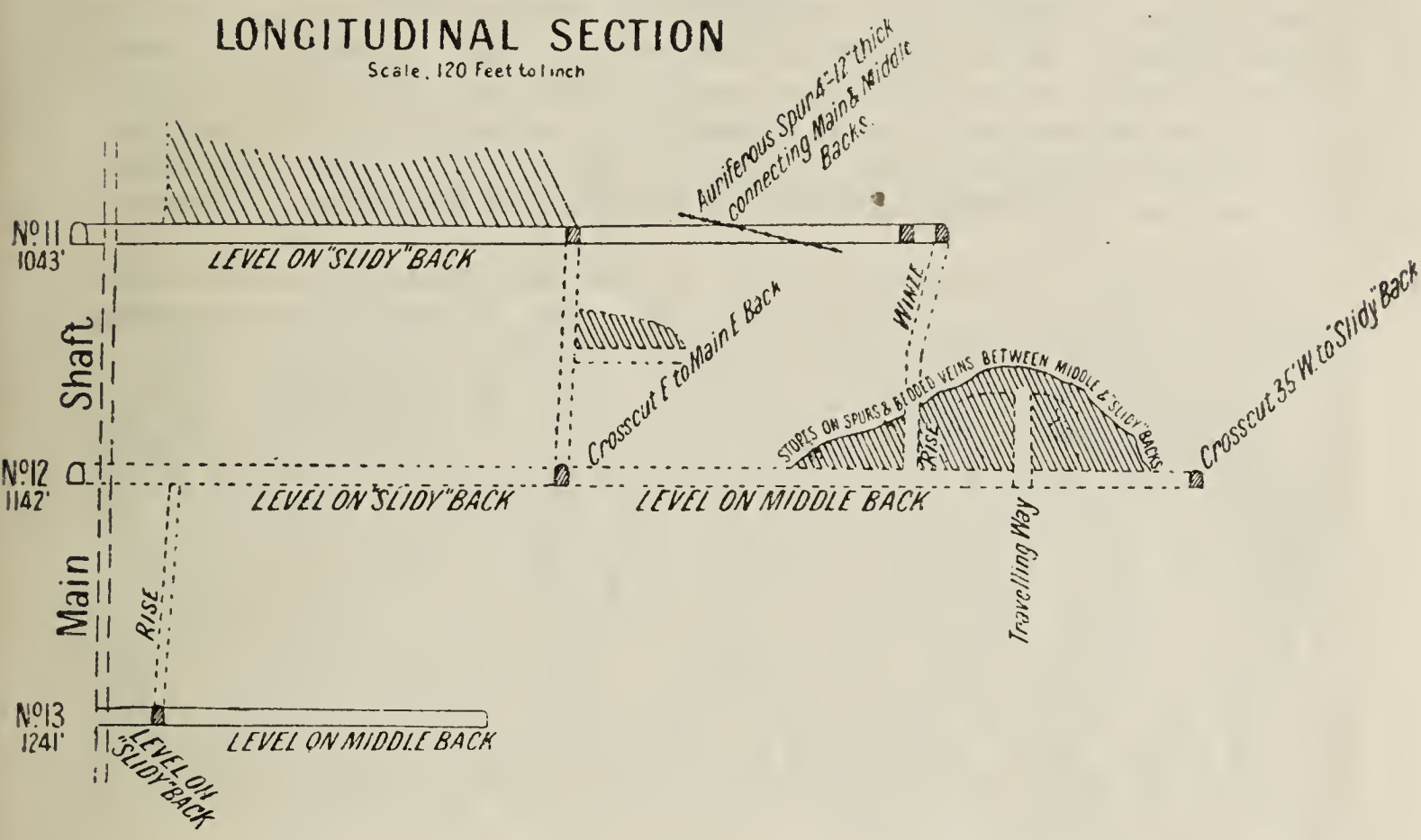


FIG. 106. Longitudinal section. Scale: 120 feet to 1 inch.

1. To connect the No. 11 Moon north level with the No. 10 Suffolk south level preparatory to extending the Suffolk No. 10 main cross-cut westward to the Moon main west back.
2. To drive a cross-cut eastward from the end of the Moon No. 11 (1,043 feet) level (which is on Scadden's back), to Bowden's back, distant about 60 feet.
3. To heighten the rise on Scadden's back now up about 20 feet above the 1,204 feet level near the Suffolk shaft.
4. The extension of upward stoping on diagonal spurs being worked over the Moon No. 13 (1,241 feet) level at 430 feet north of the Moon shaft.

Owing to complications due to folding, a wrong impression has prevailed as to the relative positions of the levels referred to in proposal (1). It has been thought that the levels being far enough advanced to overlap a jump-up from the end of the cross-cut from the face of the Moon level would hole to the Suffolk level. According to a plot of field notes this is not so, and to effect a connexion the cross-cut referred to will have to be extended approximately 40 feet westward. With a connexion made, the levels would afford a good travelling way from shaft to shaft (800 feet apart) along which machinery and material could be conveniently carried from the Moon shaft to the Suffolk No. 10 main cross-cut which it is proposed to extend. The

head-gear having been removed from the Suffolk shaft, the carrying out of this work is necessary as a preliminary to driving for the Moon main west back, estimated to exist at less than 50 feet beyond the end of the cross-cut. The stone on this back was very rich in the Moon mine at between Nos. 8 and 9 levels, capping just above the former. If, as appears from the cross section of the mines, it is the west leg of the reef of which Scadden's back is the east leg, then both Scadden's and Bowden's matching backs should be intersected within 100 feet of cross-cutting. With better facilities for attack this work would be recommended. It is doubtful, however, in the prevailing circumstances, whether a struggling company would feel justified in expending the capital necessary to the undertaking, especially when it is known that the west leg just under Scadden's cap at No. 9 (100 feet above) and the west leg of Bowden's at No. 8 (200 feet above) proved poor.

With regard to proposal No. 2, as the accompanying section indicates, the project is a sound one. In, say, 60 feet of cross-cutting from the end of the Moon No. 11 level, Bowden's back should be cut at a point (in what might, on account of the ill-conditioned shape of the original leases, be styled "no man's land") at which the continuation of the old Suffolk chute worked to the old mutual boundary should be found. Prospecting for the upward extension of this chute was undertaken by the Suffolk Company southward at No. 9, but, as the section indicates, at too high a level. A massive reef was opened up here for a length of 90 feet. Though a little gold and much mineral were seen the stone was not payable. The proposed cross-cut would intersect the back at rather more than 200 feet south of the Suffolk No. 10 stopes, and, perhaps, a few feet below the base of the chute. Prospects warrant the expenditure of the small amount required to carry out the proposed work.

The defunct New Moon Company owed much of its success to the consistent yields won from the east-dipping formation known as the main east reef, a spurry mass connecting the Moon and Scadden's backs. Most of the work done by the Bendigo A1 Company is on the northerly continuation of these spurs. At times specimen gold has been found, but, on the whole, from stopes 20 to 60 feet high, 250 feet long, and 20 feet wide, the returns have not been profitable. The intention now is to prospect the reef channel still further north, that is, close to the Suffolk shaft, where the old company in cross-cutting east at a depth of 1,204 feet reported passing through "12 inches of stone showing good gold." This, northwards from the cross-cut, apparently pitched underfoot and was not followed. Southwards, the stone enlarged, and colours of gold being seen, a rise was put up 20 feet, the reef now showing 8 feet of quartz between Scadden's and the Moon backs. Assuming a slight flattening in angle of pitch, this may be the continuation of the chute of stone now being worked further south in the stopes above the Moon No. 12 level. The extension of the old Suffolk rise is, according to a newspaper report, now in progress. It will disclose the extent of stone existing. There is nothing to indicate that an improvement in value on that of the stone in the working stopes may be expected here.

The only other work in hand at the mine is stoping at between 30 and 40 feet above the No. 13 level on a system of diagonal spurs, 6 to 8 feet wide, which conjoin Scadden's and Bowden's backs. They dip southerly, and, in the connecting cross-cut, from the first few firings

specimens equal to any found in Bendigo in recent years were dislodged. In rising, however, the country became blocky, the quartz broken, and the prospects less inviting. Nevertheless, in the back of the stopes the formation is consolidating and more resembles that portion first opened out on. Rising would be good prospecting.

Proposals (2) and (4), put into effect, would seem to hold out most promise.

[11.4.22.]

GREAT SOUTHERN MINE, BENDIGO.

By H. S. Whitelaw.

After a successful career extending over many years the Great Southern Garden Gully Company ceased operations a couple of years ago, and disposed of its plant and lease to Messrs. Bear Brothers, of Melbourne, who have since carried on some desultory prospecting on reefs which had been worked by the company. No attempt has been made by them to locate new formations for the reason that, according to plans of the mine, with one exception, no undiscovered reefs exist in centre country. The exception is Ladam's reef, which has been worked throughout the central portion of the field, but has not been seen south of the South Garden shaft, about three-quarters of a mile north, where it is small and poor. The position of its cap west of the Great Southern shaft, as indicated by east and west backs in the No. 3 cross-cut, should be above the level of No. 2 plat, and a cross-cut at a depth of about 230 feet should reach it in about 100 feet of driving.

The first reef worked by the company was the Garden Gully saddle at a depth of 351 feet, the cap being about 30 feet above the cross-cut. This is worked out. Below it prospecting at depths of 421 feet, 522 feet, and 622 feet disclosed nothing of importance.

At No. 7 level (742 feet below sill), just above which centre country crosses the shaft, there are workings on either side. On the western there is a level north in clean country some 700 feet in length, and from the end of it a winze 30 feet deep to a massive formation known as Spion Kop, on which there are open stopes over a length of 1,200 feet. Some crushings from this, the manager states, yielded as high as 14 dwt. of gold per ton, but the bulk of it was low grade. The stone—there are thousands of tons standing—has, generally, an attractive appearance, but the exposed surfaces are just below the pay mark (reckoned at 4 dwt.). East of the shaft there are levels north 100 feet and south 300 feet on an east-dipping reef 2 to 4 feet wide. At the end of the former there is a rise up 50 feet, from the top of which there are short drives (about 30 feet in length over all). The stone broken from these, it is said, yielded 140 ozs. of gold. Men working here last week saw colours in the south face.

At No. 8 (793 feet below sill) on the eastern side of the shaft there is a strong west-dipping slide carrying a good deal of quartz of no value where penetrated. On a leader and spurs above this there is a level south about 150 feet in length. Gold was seen in driving.

At the next level (866 feet below sill) there are extensive workings on 8 feet to 30 feet of quartz on an east-dipping fault forming the neck of the "900-ft." saddle reef, which has been stoped in places to the next level below. There is a great amount of quartz standing at and above this level, much of it of such good appearance that tributors have been tempted to sample it. The last three crushings averaged 3 dwts. of gold per ton.

On the same wall 80 feet east of the shaft at No. 10 level (945 feet) the reef, here an east leg, was from 2 to 30 feet wide, and, especially north of the crosscut, very rich, a return of 1,000 oz. of gold a fortnight being a not uncommon yield. The north level, at about 100 feet from the cross-cut, having collapsed, an inspection of the workings in that direction was impossible, but the manager informed me that, at about 450 feet in, where the walls are 30 feet apart, only portion of the reef has been stoped, a large block remaining overhead in the vicinity of the richest part of the formation. He suggests a rise through this, and reckons that it would take two men a week to repair the level. At the time of my visit a rise was being put up at 50 feet north of the cross-cut. At the top of this, 50 feet above the level, the reef was 8 feet wide, and appeared to be turning over centre country. It contains a comparatively high percentage of galena, black jack, and pyrites, and with inclusions of black slate presented a very favorable appearance. South of the cross-cut the reef has been stoped overhead and underfoot.

Work at the two deeper levels was confined to the " 900-ft " reef, principally to the cap and east leg. The cap would appear to have been worked out to where it pitches underfoot near the south shaft (about 1,600 feet away). Northward from the No. 11 cross-cut practically the whole of the east leg has been extracted overhead, but underfoot towards the north end of the mine the reef, 16 inches wide, is said to be intact below an intermediate between Nos 11 and 12 levels. Tributors were the last to work here, and the manager states that owing to an influx of water they were compelled to abandon their block when crushing 6 dwt. of gold per ton. The No. 12 level, which is in 490 feet on this leg, would, if extended 150 feet or so, command this payable stone. Near the main crosscut (No. 11), where tributors are sinking a winze, the leg is from 8 to 18 inches wide, nicely laminated and auriferous at 40 feet below. Southward from the cross-cut the cap and legs of the reef are practically exhausted overhead, while the legs have also been underhand stoped to shallow depths. Where the cap pitches underfoot the wall, which below the saddle forms the east leg, continues upwards through centre as a narrow neck.

At No. 12 level (1,111 feet below sill) there is a short drive north on the west back, and a level 490 feet north and 230 feet south on the east leg, which is 6 to 9 inches wide. Tributors recently obtained a block on the east leg, only to find, after rails had been laid and other preparations made to work it, that the position of the proprietors' south boundry precluded the extension of the level. The inducement to prospect in this direction is the statement that in the underhand stopes below No. 11 some crushings broken from a little further south yielded 1 oz. of gold per ton. At this level (No. 12) is seen the last of the main east back, which has been followed down for about 300 feet. To intersect it at No. 13 it would be necessary to extend the cross-cut about 90 feet; at No. 14 about 125 feet.

On a 12-in. west leg, about 10 feet east of the shaft at No. 13 level (1,196 feet), there is a drive north about 45 feet, and a rise in which colours were seen.

At No. 14 level (1,296 feet) the top of the neck of the "1,500 ft." reef shows in the cross-cut. This was followed by a centre country winze to No. 15, where between converging faults, it is 25 feet wide. In the centre of it there is a level north about 700 feet in length and south about 40 feet. From the latter, at about 20 feet in, there is a cross-cut west to the east dipping slide, and at 10 feet in a winze 6 or 7 feet deep. The reef, having a southerly pitch, the north level as it progressed entered the cap which was massive, and, in places, rich. Towards the Ulster mine the formation was so broken by faulting that much difficulty was experienced in keeping open the wide stopes. Falls were frequent, and eventually occurred one of such magnitude that the company, so it is stated, though breaking 8 to 14 dwt. stone, decided to suspend operations at this level.

On its southerly pitch the cap of the reef was followed half-way to No. 16 level, at which depth (1,497 feet) there are levels on each leg—about 70 feet south and 670 feet north on the east, and 330 feet south, and 145 feet north on the west. In the south level the former has good walls, but is small; the latter is in places 8 feet wide. Both have been stoped out overhead to a line a little south of the main cross-cut.

Nos. 17 and 18 cross-cuts (1,596 feet and 1,696 feet below sill respectively) reach centre country, but disclose nothing of promise. The former, extended about 80 feet, should cut the east leg of the "1,500 feet" reef.

Water at present stands at a few feet below No. 18-ft. plat. The depth of the shaft is 2,560 feet, with plats at 2,014 feet, 2,110 feet, 2,210 feet, 2,438 feet, and 2,456 feet, and a winze 80 feet deep.

In an inspection of this mine one is struck with the immense amount of quartz still standing in the old workings, most of it highly mineralized, much of it containing a little gold. Tributors having poked about most of the levels, and failed to discover anything in the nature of a shoot, one is forced to the conclusion that from a company's point of view the future of the mine must very much depend on the opening up of new ground. The best prospects would seem to be:—

(1) In extending No. 12 south level on the east leg to tap, on its southerly pitch, the continuation of the payable stone under-hand stoped below No. 11.

(2) In extending No. 16 south level on the west leg and cross-cutting at intervals to the east leg.

(3) In cross-cutting west for Ladam's reef at a depth of about 230 feet.

(4) In extending the No. 12 north level to the tributors' winze.

In blocks of ground between old stopes there is a possibility of picking up a run of gold:—

(1) By reaching the site of the big fall north at No. 15.

(2) By continuing the rise at 50 feet north of the cross-cut at No. 10.

(3) By continuing the rise to centre country at 100 feet north of cross-cut No. 7.

All this work would be regarded as legitimate mining enterprise.

[14.12.18.]

MELBOURNE HOPE MINE, KANGAROO FLAT, BENDIGO.

By H. S. Whitelaw.

The Melbourne Hope Company holds two leases on the Christmas line 1½ miles south-east of Kangaroo Flat railway station. The shaft is about 130 feet in depth. From the bottom a cross-cut has been driven west 30 feet through east-dipping beds to the eastern "lava" (dyke), into which a hole was bored 2 feet. At 6 feet from shaft an east back (main east wall) was cut, and between this and the lava (on which there is 12 inches to 18 inches of quartz) three west-dipping spurs 2 inches to 12 inches wide are exposed. These have been tested by a level 50 feet north, and throughout its length fine gold can be obtained by dishing. At 40 feet north from the cross-cut the stone on the eastern spur (dip 68° W.) takes on a streaky structure and exhibits colours of gold along the laminations. From here onwards, for 8 or 10 feet, to a north-dipping fault, its appearance suggests the possibility of its paying to extract. Beyond the fault, and at its junction with the main east wall, the formation is not so attractive to the eye. From where the best prospects have been obtained in the level, a cross-cut goes out westward for 10 feet to a lava carrying 2 feet or more of quartz in which are colours of gold. A 4-ft. hole drilled through the dyke entered quartz.

This work is 30 feet below the deepest operations of the old-time miners, whose efforts (as were those of others all along the line) to probe deeper were frustrated by water, the level of which has since fallen 30 feet, and, perhaps, more.

By sinking a winze from the level at the off-take of the branch cross-cut two purposes would be served—the determination of water-level and the testing of the better class stone between the reef-channel proper and the eastern lava which, if its eastern dip continue, should intersect, at a depth, the "false" wall on which the level has been driven (see section A B on accompanying plan). On the striking of payable ore here will probably depend the future of the company.

The sinking of the winze to water-level and, as incidentals, the extension of the level 50 feet northwards, and the branch or main cross-cut westward 25 feet, is good prospecting.

The country and the northern faces pitch northerly at angles between 12° and 25°, consequently, if the proposed winze revealed payable gold, it might be deemed advisable, for deeper working, to make the Crown shaft the main shaft. This is northerly from the working shaft, within the lease, and about 200 feet deep.

[19.5.22.]

KEATING AND BAKER'S CLAIM, CHERRYTREE, NEAR BENDIGO.

By H. S. Whitelaw.

The exposure in the claim mentioned is of interest by reason of its being the latest discovery outside the central portion of the field. It is between 6 and 7 miles due south of Bendigo Post Office, in the eastern beds of Fames' anticline (about midway between the better known Hit-or-Miss and Exhibition lines), and is of the type known in this office as the Crusoe, that is, a spurry formation in fractured east-dipping beds.

The solid portion of the formation is 4 feet wide, and has a westerly underlie. It has been opened up to a depth of about 30 feet, and at the bottom is now being driven on. Gold shows in both faces, mainly in fine form. From higher up—in the open cut and along the line of intersection of a west-dipping floor—coarse gold (in penny-weight-pieces) has been broken. The run pitches southerly at an angle of about 15°. This fact being recognized by the prospectors (Keating and Baker), the level in that direction will probably receive more attention than that in the other.

The occurrence, which is within a mile of the contact, is one of a score or more deposits in the altered rocks surrounding the Harcourt granite outcrop that have, by development starting in a rich patch of ore, been shown to decrease in value with depth. I see no reason to think that this one will prove an exception to experience.

A large paddock of stone is awaiting treatment. The erection of a battery in the hills close by appears to be nearing completion, so a crushing may be put through before Christmas.

[2.12.21.]

THE THREE MACS MINE, CRUSOE, NEAR BENDIGO.

By H. S. Whitelaw.

The Three Macs workings, 7 miles south-south-west of the centre of Bendigo City, are in the eastern beds of the western anticline of the Break of Day, on the Crusoe belt of country, in which, so far as they have been tested, outcrops are auriferous only between Break of Day Gully on the north and the Big Hill range which fringes the Harcourt granite—a distance of about 4 miles. Within this length, and a width of half a mile, about twenty timbered shafts have been sunk, half a dozen of them reaching water. From each rich stone has been hauled.

Although the Crusoe strip is folded similarly to that of the Bendigo belt proper, no deposit resembling a saddle reef has been worked in it. Spurs associated with faults and backs in east-dipping strata have furnished practically all the gold won up to date, and, in the case of the Three Macs it would seem that future prospects depend on the continuance and recurrence in depth of the spurs which have already been opened up within the lease. These have been prospected by open-cut and from two shafts, the latter 56 feet apart. Through the

shallower north shaft (about 50 feet deep) an east back crosses at about 20 feet below surface. Spurs connected with this have (by previous holders) been worked northward on a northerly pitch for some 50 or 60 feet in length. Underneath there are two south-east-dipping faults 4 feet apart, from between which the present owners crushed 12 tons of quartz for a return of 4 oz. of gold. The south shaft sunk to cut this run of stone stopped at a depth of 74 ft. 6 in., and short of its objective. An unladdered winze sunk 20 feet deeper is said to have passed through auriferous stone supposed to be connected with the Three Macs reef, but faulting complications revealed in the plat render the position uncertain.

The position of this shaft is suitable for the deeper testing of the quartz makes already disclosed in the vicinity, and if the committee appointed by the shareholders to make the necessary arrangements is successful in its endeavour to float a company, the enlargement and the deepening of this so-called main shaft would, no doubt, be the first work undertaken.

While fine gold can be washed from the country anywhere within 10 feet of the exposed fault reefs (they would be styled flat makes on some other fields), the highest value appears to be confined to a band of altered blue slate, a type of bed which, in its altered form, further away from the granite, has, within the Crusoe belt, been called an "indicator," and looked upon as possibly having influenced the deposition of gold nuggets, for the shedding of which the Crusoe area was, in the early days, noted. In the Three Macs it is about 8 feet wide, and dips 75° east. The flat makes intersecting it dip 30° to 40° south-easterly, and it is along the line of intersection of the two that, at the south-west end of the field, gold shoots have generally been found. The one yield of nearly 7 dwt. of gold per ton (previously quoted) is just about payable. There is more stone of similar quality in the stopes, but how much more, and whether any of higher value at deeper levels, future operations may determine; the show is not sufficiently opened up to enable one to form an estimate.

There is nothing uncommon in the mode of occurrence here. The workings are on what 50 years ago were known as Judge's Reef (shown on R. A. Murray's plan of Bendigo Gold-field, published in 1873), and being just within the contact metamorphic zone surrounding the Big Hill or Harcourt granite are the farthest south of any on the field.

The gold both in the country rock and in the quartz is very fine, but the recovery of a high percentage of it presents no insuperable difficulty. Working in the same belt, about a mile northward and under somewhat similar conditions as to fineness of gold and texture of rock, Buttrey's Reward people found by assay of tailings and slimes that only trifling values were lost in crushing.

[8.2.19.]

AXEDALE MINE, NEAR BENDIGO.

By H. S. Whitelaw.

The Axedale mine, which is situated 11 miles east of Bendigo, and about midway between Acott's and the Fosterville lines of reef, was inspected by me at the end of December, 1908, when the shaft was

160 feet deep. At 150 feet below the sill, and at 89 feet west of the shaft, a level had been driven 52 feet north on a nearly vertical reef (dip 87° E.) 4 feet to 8 feet wide. Previous to the Axedale Company taking over the lease, Hennessy and party had opened up the reef to a depth of 80 feet, and obtained crushings varying between 4 dwt. and 4 oz. of gold per ton, the last averaging 12 dwt. By the directors' reckoning the company's work, prior to my inspection, revealed prospects that justified the purchase of a ten-head battery, through which, after erection on the lease, passed, according to the quarterly returns published by the Mines Department between 31st March, 1909, and 31st December, 1910, 658 tons, yielding 224 oz. 19 dwt., an average of 6 dwt. 20 gr. per ton. Of this, according to a statement by Mr. I. Hennessy, one of the original prospectors, a crushing of 38 tons returned 21 oz. from stone broken from a winze which was sunk from the north level to a depth of 18 feet to determine whether the value of the reef below the level warranted the deepening of the shaft. The reef, according to the same authority is, at this depth—168 feet below sill—18 inches to 20 inches wide. On these figures the proposal to sink another lift appeared inviting enough, and so arrangements were well in hand to carry out the directors' determinations to see the reef at a depth of 250 feet, when the whole of the surface equipment, including the collar of the shaft and the top ladder therein, was consumed by fire.

No work has been done since then (1910), but recently the lease surrounding the mine was repegged, and a syndicate intends to endeavour to pick up the downward continuation of the gold shoot.

From information received, after I have had diligent inquiry made as to what has been done since my inspection, it would seem that if the mine be reopened it will be found that at a depth of 150 feet there is a cross-cut extending west from the shaft for a distance of 110 feet through east-dipping beds. In this at 60 feet out there is an east back (recorded in my notes) dipping 75°, and at 89 feet levels 170 feet north and 45 feet south on the Axedale reef. In the north level a winze 18 feet deep, showing the reef 18 inches wide, carries gold. Above the level the gold shoot has been stoped out.

[3.7.20.]

AJAX STAR MINE, DAYLESFORD.

By W. Baragwanath.

The Ajax Star mine is situated about $1\frac{1}{4}$ miles south of the Daylesford Post Office on the eastern side of the Ballan-road. Some rich quartz veins worked by Foletti in 1914 to about water level formed the objective of deeper workings by the present company.

The main shaft is now sunk to a depth of 360 feet, and five levels have been opened, the deepest being No. 5 at 345 feet from surface. Operations being confined to the lower levels, and the upper levels being dealt with in previous reports, a summary of the deeper working only is here given.

At the lowest level (No. 5) a short cross-cut west of the shaft passed through several spurs in broken strata, and intersected two faults at 30 feet, on which a short drive north was put in. Owing to much water being struck in this direction, no further work was done, which is to be regretted, as much quartz appears to occur in this direction.

A cross-cut now being driven east from the shaft is in 70 feet in east-dipping strata. At 20 feet from the shaft a rise (No. 1) was put up on an east-dipping bedding plane to an intermediate level, just prior to reaching which a body of quartz was cut.

A drive southerly from the shaft followed a fault plane which has a dip from slightly east to nearly vertical, then west 80° as followed south.

At 70 feet south a cross-cut east cut the same plane as risen on in main cross-cut; here the distance between the two tracks is only 15 feet. At 60 feet from the shaft a rise was put up on the main fault plane with a dip to the west of 80°. A rise was put up in No. 2 cross-cut on the east-dipping fault to the intermediate level.

In the main drive to the south of No. 2 cross-cut the wall turns to a more westerly dip, and carries 2 inches of pug. At 130 feet from the shaft the shoot of quartz, which forms at the intersection of the east-dipping and west-dipping tracks, comes in at 10 feet above the rails pitching south, and consisting of quartz 2½ feet wide; it was proved by a rise to live for a height of 12 feet, above which a slide crushes the reef out, and nothing is met until 40 feet over the rails, where a body of quartz was found below the intermediate level.

At 150 feet in the south drive the reef came down, and at 165 feet the broken or slide country came into the face. In the face at 225 feet, east-dipping strata show with spurs, on which a cross-cut east is now being driven.

In the intermediate level the reef was found 3 feet below the level in No. 2 rise, and from the south drive No. 3 rise at 70 feet was put up on an east-dipping bedding plane carrying a little quartz, which makes at 40 feet over the drive into a lode 5 feet wide dipping east, and worth up to 3 dwt. 18 gr. of gold per ton on assay.

In the intermediate level, which is 46 feet below No. 4 level at 36 feet north of No. 1 rise, the bottom of the reef rose over the back. This reef has been stoped to the north of No. 2 rise, and to a height of 10 feet for a distance of 20 feet south of No. 2 rise. The stope north of No. 2 rise to No. 1 rise is through to No. 4 level, and north of No. 1 rise is four stopes high. A new intermediate level 7 feet above the main intermediate is now being extended from No. 1 rise, and shows gold-bearing veins in east-dipping strata at 61 feet from the rise.

At three stopes above the intermediate level the reef in No. 1 rise contracts to 3 feet, and carries good values. At No. 4 level the top of No. 1 rise from No. 5 level is located 3 feet east and 5 feet south of the shaft. The cap of the lode is here 2 feet under the level, while at the top of No. 2 rise 60 feet south the cap is 12 feet below the level. At 5 feet north of the shaft the reef rose to the rails, and in the north drive went over the back. At 60 feet from the shaft a reef 4 feet wide is exposed; this dips east, but has a pug wall in the

western top corner apparently west-dipping. No. 3 level 26 feet above No. 4 level shows also a face of quartz at the same distance north, but beyond this nothing has been done.

A cross-cut east was put out 120 feet at No. 3 level in east-dipping strata, while at No. 2 level cross-cuts west 150 feet and east 400 feet failed to locate any further quartz.

It appears from the workings that the shaft has intersected the chief channel of quartz, which so far consists of two acute fault planes, that dipping west being the later, faulting the east-dipping slide about 50 feet, and that near the intersection a make of gold-bearing quartz occurs pitching to the south, and the more strongly developed in the northern end. Further prospecting is warranted more especially northwards at, say, No. 4 level, while No. 2 cross-cut should be extended westwards towards centre country (330 feet west), where quartz may be found on west-dipping faults, the verticals of the Ajax mines.

The work carried on, while not altogether of a satisfactory nature to call payers, has been cheaply performed, and has proved the auriferous character of the strata, but it appears from the workings that only the cap of the formation has been tested.

[19.7.20.]

NORTH NUGGETTY AJAX MINE, DAYLESFORD.

By W. Baragwanath.

With reference to application of North Nuggetty Ajax Company at Daylesford for a number of bores to test the country lying to the west of centre country, I beg to report having visited the area and to submit the following remarks.

Work at the mine has ceased and the material from below has been drawn; the manager was away in Melbourne, consequently I was unable to go into the details of the underground workings with him but, from a knowledge of the mine under the former manager, I do not know of any of the levels having penetrated beyond centre country. This is in keeping with proved experience on this field that in the west-dipping strata it is useless to search for payable values. I do not know of a single instance on the Daylesford field where values have been obtained to the west of centre country. At the present time the mine to the north (the Central Ajax) is testing a formation in centre country which carries gold values in part, but this is at the lowest point to which mining has been carried on the field. Accepting then the axiom that the west-dipping strata are valueless, there are still the east-dipping beds west of the present line to prospect. At about 600 feet west of the Ajax line a parallel fold occurs; on this there is no reason why similar lodes to those occurring on the Ajax line should not be located. No search has yet been made for them. In view of the fact that in the Ajax mine at least six parallel and in part gold-bearing lodes have been located none of which outcrop, and at least half-a-dozen flat makes in the Nuggetty and adjoining mines also gold-bearing have been located, the parallel line is worthy of exploration. It is hardly to be expected, however, that flat makes will be found on the parallel line opposite to those on the Ajax line as these appear to be associated with

a dome on the Ajax line and the dome on the parallel line probably lies further south; this will bring the vertical lodes more nearly opposite to the "flat make" country. For this reason I consider it advisable, taking into view that the amount of ground held by the North Nuggetty Ajax is only about 500 feet in length, that the east-dipping strata on the parallel fold and not the west-dipping strata of the Ajax fold should be tested by cross-cutting and not by boring. Two alternatives are suggested:—

(*a*) To extend the cross-cut at No. 4 level 500 feet—at least 300 feet of this will be in west-dipping strata, but 200 feet should be in strata in which values may occur. At the present time this work will cost £2 10s. a foot, or about £1,250.

(*b*) The other alternative is to sink a prospecting shaft about 150 feet in depth and to cross-cut east and west from centre country to the syncline; the shaft should be about 500 feet west of the present shaft. Allowing for a shaft 150 feet deep worked with a whim or friction hoist and oil engine, the shaft will cost about £600 and cross-cutting with the same hoisting apparatus about £2 a foot, so that for a sum of £1,250 over 300 feet of cross-cutting could be provided for.

As it cannot be demonstrated that flat makes exist to the west and the general conditions being against this view, I cannot support the use of a drill to test the area and further, when the cost of drilling together with the small size of the core to be obtained is considered, the prospecting by means of a cross-cut appears to me to be the more commendable.

[10.7.19.]

NORTH AJAX MINE, DAYLESFORD.

By W. Baragwanath.

An inspection of the North Ajax mine was made with a view to establishing, if possible, the relation of the lode and the strata in the adjacent mines. At present the chief work in the North Ajax mine is at, and above, No. 3 level where north-east of the shaft a body of quartz (lode and spurs) upwards of 20 feet in width is being mined with encouraging results. The lode appears to be typical of those in Daylesford, being formed at the intersection of a counter lode with the main lode, resulting in the lode being broken by what appears to be a slide. The ore body has been proved for a length of nearly 200 feet and to a height of 100 feet. The spurs have but little pitch with a westerly dip. The strike of the lode is from N. 23° W. to N. 30° W. At a point 600 feet north of the shaft a cross-cut east was put in from a drive on a parallel lode to the west. In the cross-cut a rise was put up on a guide meeting a mass of spurs on a west-dipping fault which was thought to be the same lode as that now being worked further south. Although identical in character this formation appears to lie too far east to agree with the strike of the main workings.

In the Ajax mine at 300 feet south of the North Ajax shaft a cross-cut is being put out east at No. 9 level. This appears to have passed through the North Ajax lode, on which drives north 50 feet and south 120 feet were put in on a lode which proved to be not payable. This cross-cut is now being extended in nice slate country, and being still in quartz bearing strata it is advisable to have it extended.

Northwards from the North Ajax Company no work is being carried out, but the shaft of the Ajax North Extended, nearly 1,000 feet from the North Ajax, should, if deepened, be in a good position to develop the lode in this direction and which developments in the southern mines appear to warrant.

[13.12.19.]

LAMER AND PARTY'S CLAIM, DAYLESFORD.

By W. Baragwanath.

This party has sunk a shaft to the south-east of the south-eastern corner of Westwood and Little streets, Daylesford, about 1,000 feet to the south of the shaft of the Daylesford Freehold Company (now abandoned). To a depth of 45 feet in the prospecting shaft a fairly well-defined formation, consisting of a solid reef 6 to 12 inches wide on the footwall and spurry country on the hanging wall, is revealed. The formation exposed, which has a strike of N. 17° W., is typical of the vertical type of lode common on the various lines in the district and dips west 75°, cutting through and faulting east-dipping strata. Further driving is warranted as the material broken has yielded from 10 to 25 dwt. of gold per ton. Centre country passes on the west side of the shaft and can be traced northwards through the Daylesford Freehold workings 100 feet west of the shaft and beyond the Frenchman's mine. The anticline lies about 800 feet east of the Cornish line, which is exposed to the north-west of the prospecting shaft in Devey's tunnel. Several formations similar to that now being opened were proved to the north, but southwards nothing has been done on the line till the Crown reef, some 60 chains away, is met with.

[22.2.22.]

DAYLESFORD ALLUVIAL COMPANY'S CLAIM, DAYLESFORD.

By W. Baragwanath.

Recent work carried out by the above party at the head of Kidd's Gully puts a different aspect on a point about which, for many years, an element of doubt has existed, i.e., whether a run of alluvial worked in the sixties dipped to the south-east or to the north-west. At this date several shafts proved the presence of a hidden crater, and the lead was worked to the edge of this, and, with the object of testing whether the lead existed beyond what was first regarded as a dyke, shafts were sunk to depths of over 300 feet below the level at which the lead was lost. The lead was then thought to be running towards Kidd's Gully, but the workings now opened prove the trend in the opposite direction, that is unless foundering of the adjacent country took place with the development of the crater. A section exposed at the extreme end of the lead shows the wash practically undisturbed and overlain by a thin tongue of basalt over which is a large bed of tuff. The lead has a course obliquely on the edge of the crater and the proposal of the company is to bore to the south-east along the general

direction of the unfaulted portion. This work is preferable to driving in the preliminary stages, and, should it prove successful, a considerable extent of untried country may be opened.

[22.2.22.]

Addendum.

By Stanley Hunter.

In company with Mr. Stevens, Director of the Daylesford School of Mines, and the mine manager, I examined the surface and tunnel of the above company. A previous departmental report on this was made by Mr. Baragwanath on 22nd February, 1922, and boring was suggested. Several bores were sunk without disclosing anything of a favorable nature. The whole question of further mining hinges on whether the heads of the lead have been blown away by a volcano, the crater of which is now filled with tuff, or whether the lead may have skirted round the edge of the volcano. There is no doubt in my mind but that the heads of the lead have been so lost. Small patches of payable gravel may have been left untouched and subsequently drawn down into the crater as it filled with débris, ashes, &c.; the slow subsidence of this loosely deposited material would tend to drag down such isolated patches of wash and so encourage the suggestion that the lead still continues under the mass of volcanic ash.

Krause, in his report on Daylesford made in 1877, gives a number of records of shafts sunk to find the continuation of this lead, and although some of his figures may be doubtful, the fact remains that a very great amount of fruitless mining has been undertaken in this quest. I entirely agree with his suggestion concerning the extent of the crater, and consider that it is a waste of money to search for the lost lead.

[27.7.22.]

UNITED KINGDOM-FENTON LINE OF REEFS, TARADALE

By H. S. Whitelaw.

The inspection of the United Kingdom-Fenton line of reefs was made just twelve months ago in the company of Mr. John Cray, mine manager, and Mr. Geo. Dorman, senior, one-time miner. From these gentlemen and from Mr. Alfred Rivett, mining registrar of Taradale, most of the following information was obtained.

The locality of the main outcrop is 1 mile south of the township. The country rocks are slates and sandstones forming a 40-acre Ordovician inlier, surrounded by basalt, and traversed by the Taradale-Malmsbury main road.

Mining operations were commenced by the United Kingdom Company in Conlan's paddock in May, 1870. The first seventeen months' operations produced 4,011 oz., the yields varying from 5 dwt. to 3 oz. of gold per ton. The main (No. 2) shaft is about 200 feet deep. Between the surface and this depth the reef (cap and legs) yielded 21,000 oz. Operations ended southward where the workings entered alluvial deposits at about 250 feet from shaft, and northward at the lease boundary 240 feet from shaft.

The Fenton Company, with a lease of 330 feet along the line, and adjoining the United Kingdom ground, began operations at about the same time as the latter company, and from the same reef, between June, 1870, and February, 1872, won 7,193 oz. The shaft is about 200 feet deep, and through it 18,000 oz. of gold was raised.

Next north along the line is the Nelson mine. Here the shaft, down 600 feet, is the deepest in the channel. From it there are cross-cuts east at 220, 280, 400, and 500 feet below the sill. In sinking, the west leg of a saddle reef overlying the United Kingdom formation was passed through at 100 feet. The cap of this existed above the present surface. No gold being seen in the west leg, no driving was done. The east leg, however, has been worked to a depth of 80 feet from the surface at 110 feet east of the shaft, and from it 3s. 6d. per share was paid in dividends. Midway between these two legs the neck of the United Kingdom reef outcrops. At 100 feet below, this opens out and forms the cap which, across the saddle, is 25 feet wide. The west leg passed through the 220-feet plat and the east leg through the cross-cut at 150 feet east of the shaft. Above this level practically the whole of this reef has been extracted. Some work was done also on the legs at a depth of 280 feet. From all stone crushed 7,000 oz. of gold was recovered. In extending the 220-feet cross-cut, the cap of No. 2 reef was cut about 50 feet vertically below the saddle of the United Kingdom. According to Mr. Cray, who was underground manager, the cap is 10 feet wide and heavily charged with mineral. No work was done on it at this depth. In the 280-feet cross-cut the west leg is 12 inches to 15 inches wide, the east 2 feet to 2½ feet wide. A rise was put up on the east leg and holed to the No. 2 cross-cut. No other work was done on the reef. In deepening the shaft the west leg of No. 2 reef was passed through, and at 400 feet a cross-cut driven east cutting the cap of No. 3 reef at 90 feet from the shaft. On this there is a level 50 feet south in a full face of mineralized stone in which gold was not seen. The west leg of the reef was seen at about 50 feet east in the 500-feet cross-cut, and again in the bottom of the shaft. Without further prospecting, operations were suspended.

At about 900 feet north of the Nelson shaft the Taradale Reefing Company sank a shaft to 265 feet. At a depth of 100 feet a cross-cut east cut the 10-inch west leg of the reef overlying the United Kingdom. No gold was seen and no work was done on it. At about 120 feet out the east leg, a crushing from which, where it was broken in Martin's cellar about 100 feet south, is said to have yielded between ½ oz. and 1 oz., was exposed but not opened up. Between the two legs the cap of the United Kingdom reef occurs, its value by dish prospects being estimated at 1 dwt. per ton. This was again seen (between 50 and 90 feet east) in the 200-feet cross-cut as was the east leg of the higher reef, both being poor. The east and west legs of the United Kingdom reef were cut in the 265-feet cross-cut, but no crushing was broken from either.

Still further north—about 700 feet—is the North Fenton shaft, 200 feet deep. In a cross-cut east from the bottom the cap of the United Kingdom reef, 20 feet wide and showing gold, was entered at about 90 feet from shaft. Referring to the extension of this cross-cut through the cap, Mr. Cray states "When the work was in progress a little gold was seen in the stone which at times gave encouraging dish prospects. but unfortunately the deepening of the shaft was never carried out. The company went as far as to purchase a winding plant and a contract was let for the erection of same. A gentleman who took a big interest

in Bendigo and other mining was the owner of what is known as the Little Paddock. When the cap of the reef was found to be right on the eastern boundary of the North Fenton, the amalgamation of the Little Paddock and the North Fenton was discussed for some time, but no agreement was come to and nothing further was done." At about 30 feet east of the cap the east leg of the overlying reef, which above the cross-cut was payable, is 10 inches wide and poor.

Southward from this group of mines the anticline in which the reefs occur is covered by basalt and basalt talus until the May Queen reef $2\frac{1}{2}$ miles distant is reached. This reef yielded 1,585 oz. 3 dwt. of gold from 1,329 tons of quartz. Northwards the bedrock emerges from under the basalt and in what is known as the Lady Darling paddock, a third of a mile away, an east leg has been exposed in the Black Gutter, a tributary of Back Creek. On the same line of strike and in the Police paddock, Mr. Dorman pointed out what was his claim from which, 40 years ago, he broke crushings averaging 13 dwt. per ton. Adjoining this claim was Bell's, from a shaft in which, between the surface and a depth of 15 feet, one crushing of one ton from an attenuated west leg yielded 17 dwt. Beyond the Police paddock, which adjoins the east boundary of the township of Taradale, the line is again overlain by basalt which covers, also, deposits of auriferous wash. In a tunnel (Wyland and party's) driven to work this wash between the Police paddock and the railway station, a small saddle reef, Mr. Cray informs me, was met with, " it showed several colours of gold, but in those days it was not considered payable, and they went on after the alluvial." Beyond here the line has not been traced.

The distance between the May Queen mine and Wyland's tunnel is $3\frac{1}{4}$ miles. No work is being done between the two. There is, however, a proposal to further test the United Kingdom reef from the North Fenton shaft, the northernmost in the group of mines about which I have collected information. The one shoot already worked was about 1,100 feet in length, its northern limit being about 250 feet north of the Nelson shaft. At about 550 feet further northward the Taradale Reefing Company proved the reef a blank. Seven hundred feet still further on the North Fenton Company obtained what are termed " encouraging dish prospects " from the uppermost portion of the cap. In the three mines that worked the productive section of the reef, this portion (the top of the cap) provided the poorest results. It would seem, therefore, that there is a reasonable chance of improvement in quality with depth in the North Fenton mine. The proposition, as put to me, for further exploring the reef, is to deepen the shaft to 450 feet and drive cross-cuts eastward at 320 and 440 feet. From figures furnished and from the pitch of the country, it would appear that the higher crosscut should pass through the reef just above the saddle, the lower through the cap of No. 2 reef and the east leg of the United Kingdom reef, the west leg of the latter passing through the shaft about 30 feet above the plat.

[11.6.20.]

THE DEEP LEAD AT GUILDFORD.

By A. M. Howitt.

Early in February, 1920, a cursory examination of an area at Guildford Hill was made, following a request by Mr. Thomas Dunstan that his opinion on the relation of the basalt flows and deep lead be confirmed by a geological inspection.

He states that the Loddon River, from Kemp's bridge to the junction with Campbell's Creek, was proved by the dredges to be practically barren of gold, and that the deep lead for some distance remains unworked beneath the basalt on Guildford Hill.

It is apparent that south-easterly from Kemp's bridge the present Loddon River followed somewhat closely the trend of the old lead exposed at the edge of the basalt, and carried a large amount of gold-bearing wash from the old lead to the recent river flats.

At Kemp's bridge the Loddon turns sharply west, and cuts through the basalt and the old lead. The old lead continues northwards under the basalt of Guildford Hill, where it is protected from denudation. It therefore follows that a stretch of the Loddon River bed from Kemp's bridge to where the old lead re-appears would probably be poor in gold values.

Many years ago the old lead was worked under the Guildford Hill basalt by means of tunnels and air shafts, but it is stated that the workings were limited, and did not extend far under the basalt. False bottoms of wash show in some of the air shafts, and they appear to have been neglected.

About the middle of the Guildford Hill basalt and towards its northern end there are some shaft workings on a deep lead, but Mr. Dunstan is of the opinion that deeper ground exists westerly from these workings.

On the north-western face of Guildford Hill, in the railway station grounds, Dunstan and party have worked a series of false bottoms carrying auriferous wash and cement, and under these false bottoms a deep or main run of wash should occur.

The main object of Mr. Dunstan's inquiry was whether there are one or two basalt flows on Guildford Hill. This is of little account as far as the deep lead is concerned, but there is evidence of two flows, an upper one vesicular, and a lower one of dense basalt.

[15.4.20.]

TYRCONNEL NORTH MINE, BLACKWOOD.

By H. Foster.

Since this mine was surveyed, in February, 1921, the following work has been carried out:—

At 35 feet along the east cross-cut off the north drive from the east cross-cut off the main north drive, a drive north and a rise have been put in on a quartz spur. A short drive south was also put in. The cross-cut has been extended another 192 feet, making a total distance of 292 feet to the face. At 170 feet a syncline was cut in slate. At 213 feet a laminated bedded reef 6 inches thick and underlying west was cut; it carries a little gold. From 223 feet to 232 feet a mixture of quartz and slate was passed through. At 250 feet an anticline occurs, in which many thin quartz veins containing a little gold are to be seen underlying west. A pitch of the rocks taken near the anticline gave 27° south. Near the face two quartz leaders 1 inch thick and underlying west in east-dipping strata occur, both of which carry good gold.

As it is the intention of the mine manager to commence driving south to connect to the shaft sunk from the surface, and now down to 258 feet from the end of the cross-cut, good prospecting work would be done if the leaders in the face were followed, also a drive put along them northwards.

[20.9.21.]

MAGENTA REEF, CHILTERN.

By W. Baragwanath.

The Magenta reef lies about 1½ miles north-east of the township of Chiltern. An extensive open cut marks the site of operations, which, beginning in 1858, were continued uninterruptedly till 1901. The open cut in the eastern portion averages 50 feet in depth for a length of 150 feet by a width of 60 feet, while on the western side open stopes 20 feet in width for a length of 125 feet reach a depth of 100 feet. The walls of the cut now give no evidence of the nature of the formations worked, but the records show that several lodes with many spurs formed a stockwerke, and were mined, and that much of the mullock also was crushed. From published yields a total of 21,665 tons crushed yielded 9,900 oz. of gold, and as these are admittedly incomplete, the local report of 13,000 oz. having been obtained is probably within the mark.

An examination of the workings from the main shaft, which was sunk by the present company about twelve years ago, shows that the cross-cut south-westerly from the shaft at a depth of 300 feet passes under the main open cut. At 60 feet from the shaft the junction of two lodes is met; the eastern lode has a strike of N. 20° W., and dips 85° east, and has a width of 2 feet southerly from the junction: the diagonal, or what appears to be the main lode, has a strike of N. 1° W., and dips 75° west, and ranges from 4 feet to 2 feet in width for a total distance of 90 feet. At 70 feet southerly from the cross-cut a lode 18 inches wide branches in from the west, and changes in dip, forming the continuation of the diagonal lode; this lode in the south face is 18 inches wide. In the main cross-cut two narrow lode tracks were passed through at 90 and 120 feet; on the former a drive north was put in 50 feet, and on the latter 6 feet south. Both tracks are small. On the diagonal reef at 30 feet south of cross-cut a rise of 30 feet connects to the end of the old workings from a whip shaft south-west of the open cut, and above the level stopes are visible, but the nature and extent of these could not be determined.

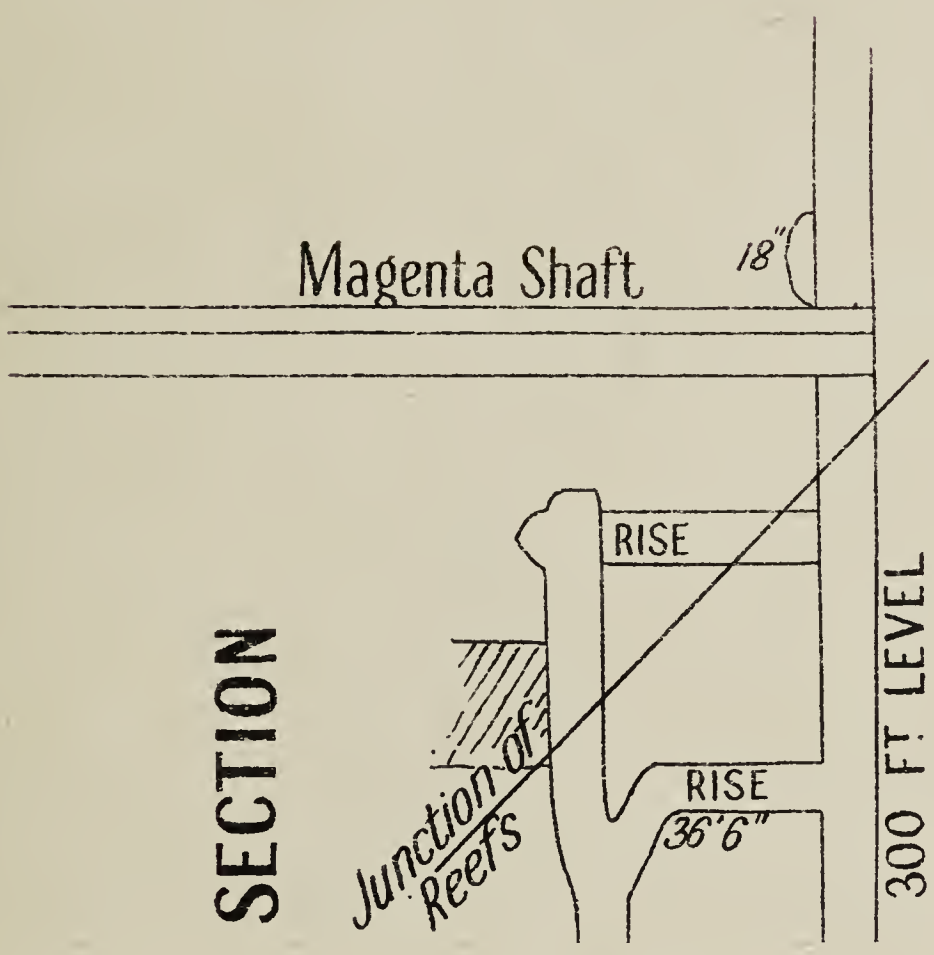
Future work is purely of a prospective nature with but few data to guide operations, but it is suggested that the west cross-cut be extended till under the centre of the 100-ft. stope from the surface, and that a drive be put in to see if any formation lives down. The value of the reefs already opened should be ascertained, but on this the amount of ground available for stoping is limited.

A plan showing the workings to date accompanies this report.

[1.12.21.]

Plate No. LII.

w Shaft



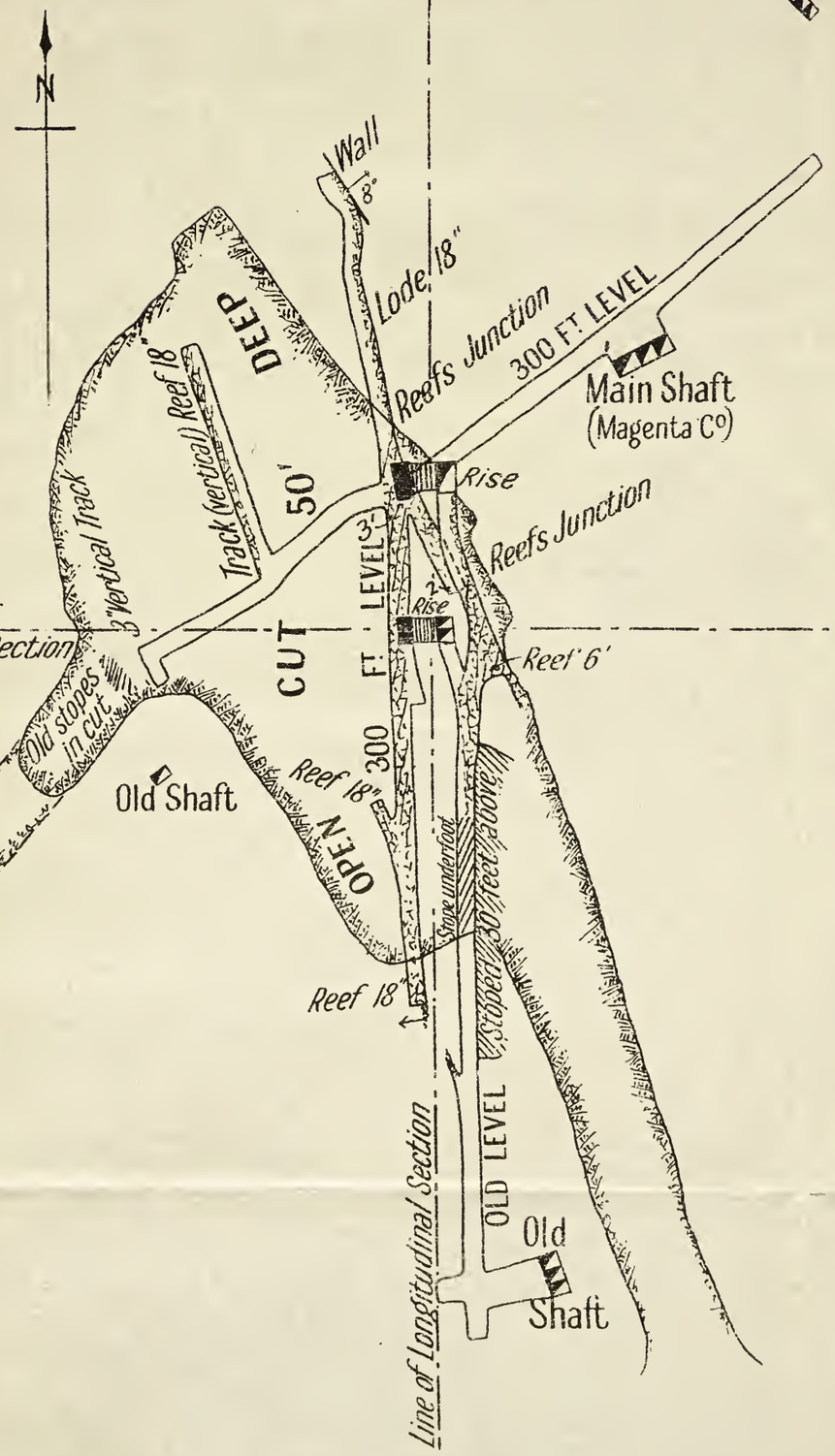
MAGENTA MINE

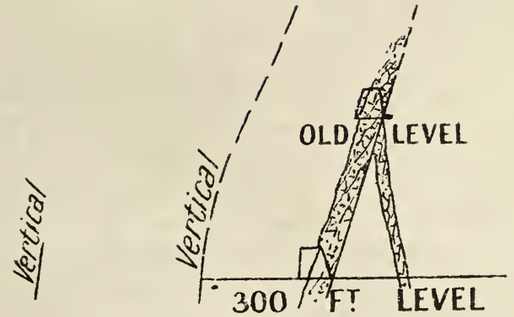
CHILTERN.

Scale. 40 Feet to 1 Inch.

GEOLOGICAL SURVEY OF VICTORIA

W. Baragwanath, Director
A. H. Merrin, Secretary for Mines
The Hon. G. L. Goudie, M.L.C., Minister of Mines.





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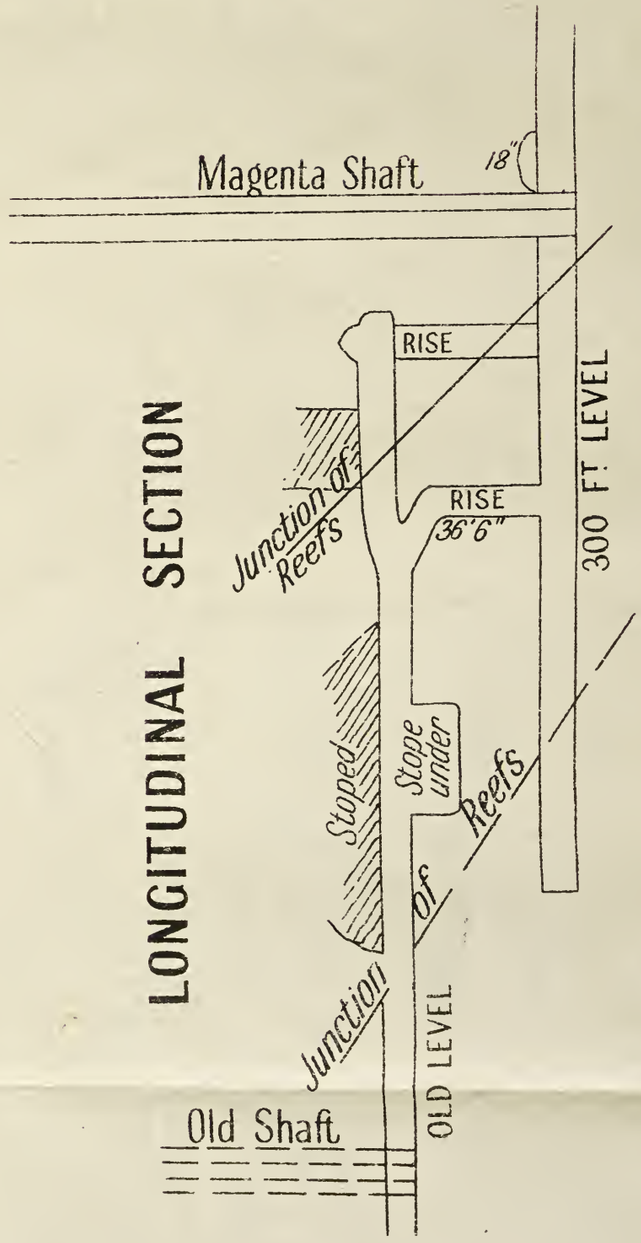

LONGITUDINAL SECTION

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LEVIATHAN MINE

ROBERTS CREEK, BRIGHT.

Scale of Feet

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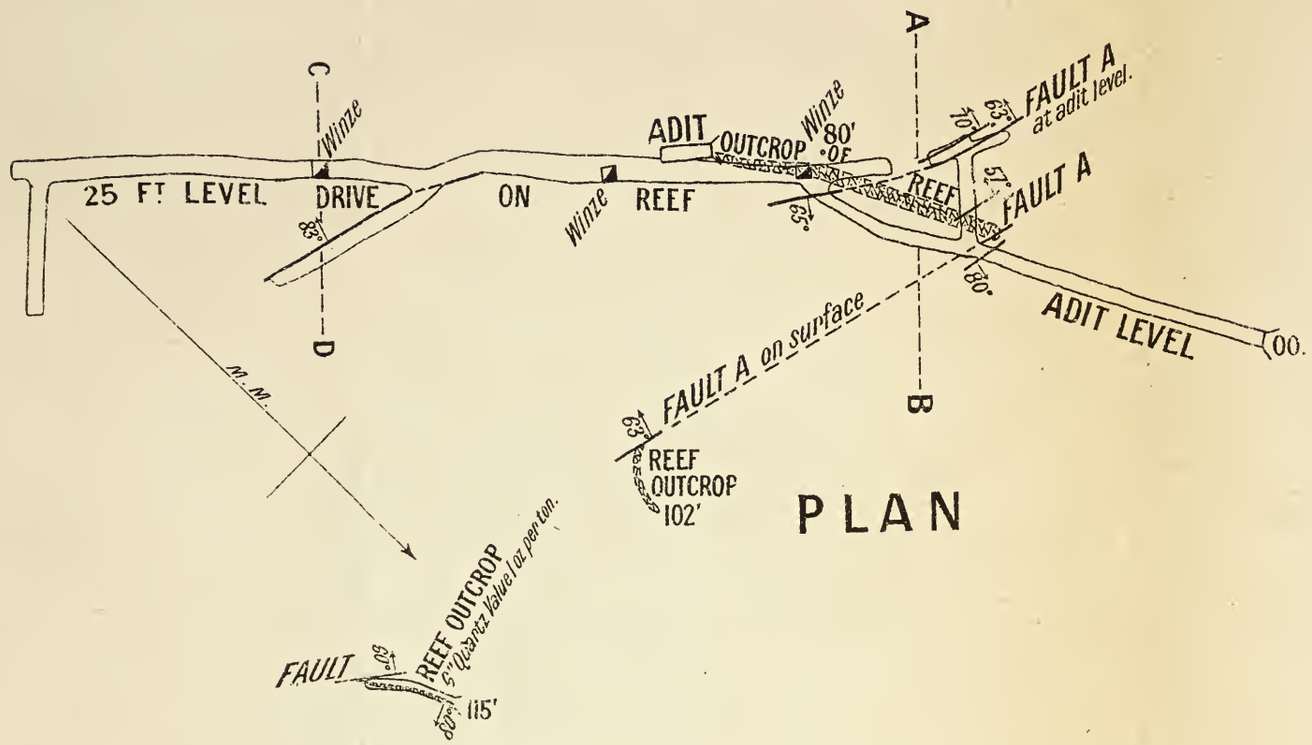


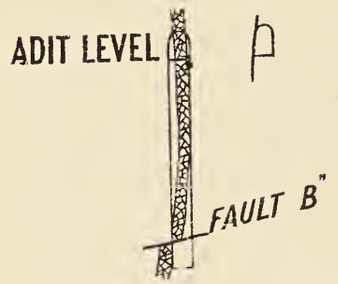
PLAN

Bearing S 45° E.

MOUTH OF PROPOSED ADIT

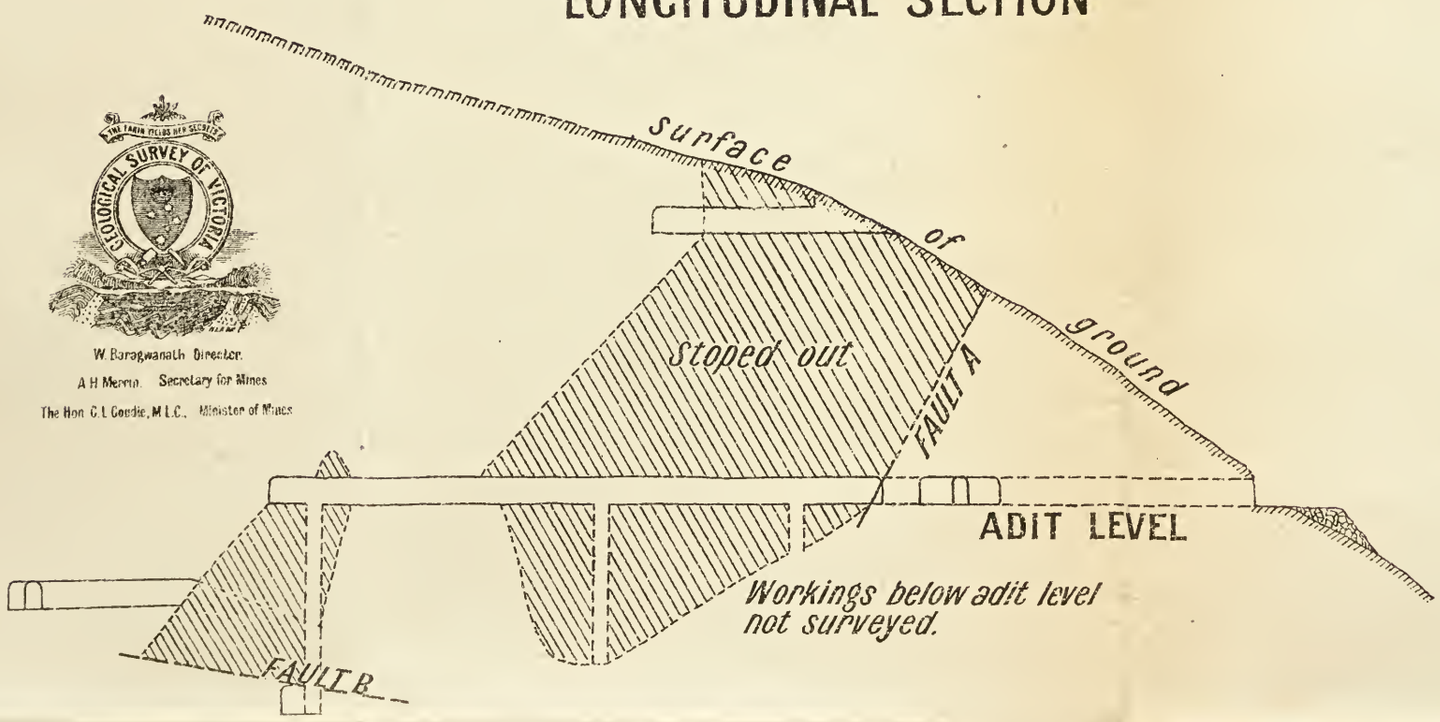
J.R.L. Revy
1.11.16

Revised to 27.3.19



SECTION C-D

LONGITUDINAL SECTION



SECTION A-B

PROPOSED ADIT

GEOLOGICAL SURVEY OF VICTORIA

W. Baragwanath Director.

A.H. Merrin Secretary for Mines

The Hon. G.L. Goudie, M.L.C. Minister of Mines

LEVIATHAN MINE, ROBERTS CREEK, NEAR BRIGHT.

By J. P. L. Kenny, B.C.E.

The following notes are supplementary to my report made in November, 1916.

The workings below the adit level, which were then under water, have now been baled out. The south winze is 40 feet deep, and a shoot 20 feet long at the level, and 40 feet long at the bottom of the winze has been stoped out. The reef is 2 feet wide, and I was informed that the stone averaged $1\frac{1}{2}$ oz. of gold per ton.

In the bottom of the winze the reef has been cut off by a fault dipping 20° west, and the syndicate intends to prospect for the reef below this fault. A similar fault was passed through in the upper stopes, and the reef below it was found about 3 feet to the west. Just above the fault the reef has a slight westerly trend (instead of being vertical as it is below the level), and it is very probable that the fault is a reversed one, as is almost invariably the case in the district, and that the reef beneath it will be found to the west. I recommend that the winze be sunk, say, 10 feet below the fault, and that a cross-cut be then extended west to prospect for the reef. Should payable stone be proved, the south winze should be sunk to at least 100 feet below the adit level, and another cross-cut put out to open up the reef.

A fault wall intersects the reef 20 feet north of the south winze, and a drive was extended 45 feet south-easterly along it at the adit level. At 25 feet below the level a drive goes 50 feet south on the reef beyond the south shoot. From this drive a cross-cut was put out 35 feet easterly, and would cut the fault wall if extended another 20 feet. This work was done under the impression that payable quartz might be found on this wall, but there is no reason why this should be so, and further work in this direction is inadvisable. To the north of the south winze there is a block of quartz 50 feet long untested below the level. As this stone may be a continuation of the main shoot worked above the adit level, it is advisable to test its value by driving north through it from the south winze.

[27.5.18.]

In the south winze a floor was met cutting off the reef at a depth of 43 feet. The winze was continued to 52 ft. 6 in., and the reef was located below the floor about 3 feet to the west of the reef above. The reef is 3 feet to 3 ft. 6 in. wide, and gold can be seen in the stone. Dish prospects indicated a value of about an ounce per ton. A crushing of 80 tons broken from the reef above and below the fault gave a return of only about 4 dwt. per ton. A sample of the stone assayed 18 dwt. per ton, and the concentrates from the Wilfley table assayed 13 oz. per ton. About 1 ton of concentrates was saved from the crushing, and globules of mercury carrying gold were present. The owners of the mine believe that gold was lost in crushing, and, in view of the assay results, that may have been the case.

It is now proposed to drive an adit 93 feet below the present adit level. The reef has not yet been located north of the fault which bounds the workings on the north. I think it likely that the reef will be found here a little to the south-west of the line of the worked reef. The proposed adit will start near the probable position of the line. It should first be driven due south for 20 feet or 30 feet to

try to locate the line. Failing this, the most favorable country near the face could be selected for the drive, which must have a bearing south-east. The proposed adit will intersect the reef south of the fault at 250 feet, the continuation of the shoot at 350 feet, and the adit should be extended to 470 feet.

[27.3.19.]

ORIENTAL MINE, WANDILIGONG.

By J. P. L. Kenny, B.C.E.

At the Oriental Mine the main cross-cut in the Long Tunnel has now a length of 4,500 feet. For the last 125 feet the cross-cut is in clean country with a regular westerly dip of 55° to 63°. No further reef channels were intersected. On the reef cut at 3,918 feet, the south-east drive (in which a vein of aurifercus quartz was cut) is 424 feet long. A drive has also been extended north-west on this reef to 374 feet from the main cross-cut. The formation varies in width from 1 foot to 4 feet with a westerly dip of 67° to 78°. A heavy flow of water was cut in driving on this reef, but the formation carries no gold.

From a gully to the north of the open cut a tunnel has been driven south on the Oriental line at a depth of 271 feet below the Australasia adit. This tunnel on 8th August, 1922. had a length of 1,652 feet with cross-cuts at intervals as follows:—

At	330	ft. cross-cut	68	ft.	east
,,	473	,, ,,	67	,,	,,
,,	720	,, ,,	220	,,	,,
,,	938	,, ,,	300	,,	,,
,,	1,117	,, ,,	80	,,	,,
,,	1,512	,, ,,	75	,,	,,
,,	1.585	,, ,,	22	,,	west

The drive follows what appears to be the main Oriental wall for its whole length. Other reef channels have been proved in the cross-cuts east, and these junction with the main wall going south. In the cross-cut west at 1,585 feet, what is probably the footwall of the Oriental dyke is cut at 9 feet from the reef channel and dips 75° west. A reef 4 feet wide shows at 1,400 feet in the tunnel, but for the most part the lode carries only a foot or two of reef formation. A little gold was got near the mouth of the tunnel, but beyond this the reefs where cut are not auriferous. At the Australasia adit level, a north drive 460 feet in length follows a well-defined wall with quartz up to 10 feet in width on either side of it and stopes on this stone extend in places below the level. The country in this adit pitches south, and it is probable that these large formations will be intersected by an extension of the adit now being driven from the north. In the north adit a vertical reef 3 feet wide was cut 30 feet east of the main drive in the cross-cut east at 1,512 feet. This reef will probably junction with the line in the main drive at a point about 80 feet south of the face, and an improvement in the size and value of the lode may occur at this point. From the Australasia adit a winze known as Sharpe's

was sunk to a depth of 110 feet at a point 30 feet south of the cross-cut. The face of the north adit at the time of the survey was 165 feet from Sharpe's winze. The adit should be extended to this winze and a rise put up to connect with it. By so doing the ground between the Australasia adit and the north adit levels would be tested at a minimum cost.

[8.9.22.]

WILSON'S REEF, FREEBURGH.

By J. P. L. Kenny, B.C.E.

Wilson's Reef is situated on the north side of Smoko Creek, a tributary of the Ovens, 6 miles north of Harrietville. The reef is a well-defined line, strike west 30° north, and dip north 80°, and averages about 1 foot in width. The reef was discovered and worked by three brothers named Wilson. They drove two adits and sunk a winze 25 feet below the No. 2 adit, stoping the main shoot to a total depth of 80 feet from the surface. The shoot is about 25 feet long, and the stone crushed (about 60 tons) yielded 1 oz. and 2 oz. of gold per ton. At 25 feet in the winze the water was too heavy to permit of further sinking, and the Wilson brothers started No. 3 adit 121 feet below No. 2. They had driven No. 3 adit 140 feet when they left for Western Australia, then in its palmy days. The present proposal is to extend this drive to cut the shoot worked in the winze. The No. 3 adit is 96 feet below the bottom of the winze, and to test the shoot it should be extended 180 feet.

Just above the No. 1 adit the reef has been worked on the surface for a distance of 120 feet. The No. 1 adit is driven on the line which for 45 feet carries 1 inch of quartz. The reef is then disturbed by a small cross-course fault with a right-hand heave of 4 feet. Just beyond the fault is a small block of stone 2 feet wide. From my inspection, I am of the opinion that beyond this fault the drive is on the western side of the reef, and a few shots in the wall here may disclose stone. It is 12 feet from the fault to the face, and the drive at present shows no stone. I am not aware of the value of the stone taken from the surface stopes above No. 1 adit, but should stone be cut here giving payable prospects, the extension of the No. 1 adit for 60 feet would be advisable.

[6.7.15.]

NEW WATERLOO COMPANY, MYRTLEFORD.

By J. C. Grieve.

The lease applied for is located east of and adjacent to the Barwidgee Creek valley, at a point distant about 4 miles north-east of the Myrtleford railway station.

Ordovician rocks outcrop on the area and its vicinity. They are highly inclined and strike 30° west of north.

On the lease several reefs were located about 60 years ago, and were exploited by small parties or syndicates to shallow depths by means of shafts and adits. The most important of these reefs were:—

(1) The Big Waterloo and its eastern splice, the Little Waterloo.

(2) Lane's reef and its eastern splice, the Quatre Bras.

(3) The Agamemnon.

The Big Waterloo reef outcrops for a distance of about 900 feet along the crest of a fairly steep and rocky spur rising from Barwidgee Creek flats. Its strike is almost identical with that of the adjacent country rock; the underlay is very slight and toward the east, but becomes greater towards the south.

Along the outcrop several shoots of auriferous quartz have been stoped to depths of possibly 40 or 50 feet. Most of these workings have collapsed, but from what can be seen none of the shoots exceeded 30 feet. in length; they were probably less than 3 feet in width, and pitched as much as 25° from the vertical towards the south. At a point 500 feet south of the most northerly outcrop the reef throws off a splice known as the Little Waterloo reef, which strikes about 45° west of north. The Big Waterloo reef to the south of this junction decreased in width, but from the extent of workings along the remaining visible outcrop—300 feet to 400 feet—gold values were much greater.

The outcrop of the splice reef continues to the south for nearly 300 feet, from the intersection. This reef also decreased in size, and provided two shoots of payable stone to at least 40 feet in depth.

An adit level commanding about 120 feet of backs was driven southerly along the Big Waterloo reef from its most northerly outcrop for 520 feet until the junction of the splice was reached. The drive was then deflected to this Little Waterloo line, and continued for 40 feet.

The formation exposed in the drive averages about 5 feet in width up to the junction. The stone generally was poor, and only at two localities, about 200 feet apart, where there was a little rising and winzing done, is there any appearance of better values having been encountered. In the adit section along the Little Waterloo the reef ranges up to 2 feet in width, but nothing of value was found. It appears highly probable that had the adit been continued a further 300 feet along the main channel, the downward continuation of three or four auriferous chutes would have been opened up; or, that by extending the present face on the branch line 150 feet, both of its surface chutes would have been cut.

Lane's reef and the Quatre Bras splice reef, which outcrop for nearly 1,000 feet on the adjacent spur 250 feet to the west, are parallel, and very similar to the Waterloo reef and its splice. The splice strikes south 45° east, and is named the Quatre Bras line. Several payable shoots varying up to 35 feet in length and up to 3 feet in width were worked along these channels, but chiefly to the south of the point of intersection.

A low level adit was driven southerly to the junction of the Quatre Bras and Lane's reef, and was then deflected for 60 feet along the former channel. The entrance to this adit was choked, and I was unable to examine the reef exposed at this level. Apparently, as in the Waterloo adit, an error was made, and the adit was deflected to the minor splice channel.

There appears to be a good chance of locating auriferous shoots by extending Lane's adit level a further distance of 200 or 300 feet on each of these channels.

The Agamemnon reef lies nearly parallel to those mentioned above and about 200 feet still further to the west. I was unable to gain much information concerning this line beyond that it was opened up for about 400 feet, and exploited to possibly 150 feet in depth by an engine shaft, &c., and that it contained three or four short and rich shoots of quartz.

In considering the advisability of resuming prospecting operations on this lease, the undermentioned factors should be taken into account—

(1) The extension of any of the adit faces is likely to cost at least £2 per foot.

(2) It is unlikely that the early miners left any payable stone in sight at the bottom of shoots stoped from the surface. Payable stone, however, may be located in some of these shoots at a lower level, such as an extension of 200 feet on either of the Big Waterloo or Lane's reefs, or their respective splices from ends of existing adits.

(3) From records available of the values of shoots exploited in the past, it must be recognized that although patches of highly profitable stone were encountered, the general average value of the mine output is rather low for the existing high costs of mining.

There is, however, a possibility that if further enrichments are located in the reef at the adit levels, the average values may be payable under present conditions, and the venture prove successful.

To test this I would advise that the adit level on either the Big Waterloo or Lane's reef be continued a distance of 250 feet. A rise to provide ventilation would also be necessary. I would estimate the cost as £1,000.

Should encouraging results be obtained, a further scheme of development could be laid out to test and open up the other reefs.

[4.10.22.]

ROSE, THISTLE, AND SHAMROCK MINE, HARRIETVILLE.

By J. P. L. Kenny, B.C.E.

Landtax Reef.—On the Landtax reef the main underlay shaft has been sunk to a total depth of 415 feet below the main adit level. Down to 300 feet good values were obtained both on the arch of the reef and on the Shamrock wall at its intersection with the Landtax reef. Below 300 feet the arch of the reef narrows considerably, and in the bottom it is little more than the width of the shaft, with a steep dip to the north, and to the Shamrock wall on the south. With the contraction of the fold the gold contents decreased. The value

of the stone passed through justifies further sinking on the Landtax Reef, and the underlay shaft should be continued. As a preliminary the shaft could be straightened from top to bottom, and the alignment kept in further sinking. The shaft is well located for further development of the reef; there is practically no water, and the ground stands well.

In driving east on the Shamrock wall at the adit level a new formation was cut 115 feet east of the Landtax and Shamrock junction. This formation also shows at the Nos. 2 and 3 levels. Its appearance suggests that it may be a saddle formation similar to the Landtax, with payable stone on the crown of the reef. This formation should be tested by driving on it at the adit level, and also at the No. 3 level. The drives should extend to the crown of the reef, or far enough to determine the nature of the formation—20 feet or 30 feet should suffice. If a saddle reef were proved it could then be further prospected by rising on the crown of the reef.

The Shamrock Reef.—On the Shamrock reef a main vertical shaft has been sunk with a level at 126 feet below the main adit level. A drive of 80 feet from the shaft intersects the syncline, and drives have been extended 130 feet east on the Shamrock wall and 145 feet south on the west leg. On the latter a shoot 12 feet long was cut 110 feet south of the syncline, and was stoped up 40 feet. On the Shamrock wall at the 126-ft. level payable stone extended for 33 feet from the syncline. At 90 feet in the east drive a second shoot 55 feet long on the level was cut and stoped up about 50 feet. The first shoot has been stoped up 45 feet to an intermediate level.

An underlay winze has been sunk in the syncline to a depth of 22 feet below the 126 feet level, and in the bottom of the winze the reef is 8 feet wide, and worth 2 oz. per ton. The reserves of payable stone above the 126 feet level are limited, and the future policy of the company is a matter for immediate consideration. While the reef in the syncline maintains its value the present winze may be continued, but when the winze reaches the eastern limit of the shoot, which will be at about 60 feet on the underlay below the adit level, the value of the stone in the syncline may not be maintained. From the surface to the present bottom level the length of the shoot on the Shamrock wall has consistently shortened with depth, with a corresponding increase on the west leg, and the indications are that ultimately the whole of the shoot will be found on the west leg.

For further sinking on the Shamrock reef there are three schemes which merit consideration—

(1) To sink the main shaft.

(2) To connect the present winze with the adit level by rising in the syncline, making a main underlay shaft following the syncline.

(3) To sink a main underlay shaft on the west leg pitching south so that it would not intersect the syncline.

(1) The first scheme has much to recommend it. It can be started without much preliminary expense, and it does not involve a second handling of the stone. On the other hand, the site of the shaft is not suitable for working the reef to any considerable depth on account of the long drives that would be necessary to intersect the reef. The

shaft would better have been placed at least 200 feet south-east of its present position. A further sink 126 feet below the present bottom level will require a drive of 180 feet to intersect the syncline, the nearest point of the reef. Water gave considerable trouble in sinking the present shaft, but as the next sink will be in the foot-wall country further away from the lode channel, possibly the water to be dealt with will be less than that encountered in the first sink. A cistern would be necessary at the 126 feet level.

(2) The second scheme—to sink a main winze in the syncline—would have the advantage of readily commanding both walls, but as already pointed out the indications are that, ultimately, the shoot will be all on the west leg. Another objection, and a serious one, to this scheme is that the ground in the syncline is very wet and heavy, so much so that I consider it would be almost impossible to keep such a shaft open without a heavy outlay, especially with adjacent stopes on both sides of it. As already mentioned, while the syncline carries payable stone, the present winze may be continued.

(3) The third scheme, to sink an underlay shaft on the west leg pitching south clear of the syncline, offers an alternative to sinking the main shaft. Most of the water makes on the Shamrock wall, and the south end is comparatively dry, so that water in sinking is not likely to be very troublesome. Also, judging by the pitch of the shoot above, this shaft is likely to be in closer touch with the shoot at a depth than a winze in the syncline would be.

Above the main adit level there is one block of stone which seems worth testing. It is situated between Higg's rise and the east rise. It has been stoped from the main adit level to an intermediate level 50 feet above. From this intermediate to the old bottom level from the shaft, a vertical distance of 164 feet, this block of ground does not appear to have been prospected between the rises. It could be tested by a drive west of 75 feet from the east rise at a point about 160 feet above the main adit level on the underlay of the reef.

[12.9.22.]

GLENGARRY MINE, TIN HUT REEF, NEAR TALLANGATTA.

By John G. Easton.

The Glengarry reef is situated on Jarvis Creek, parish of Tatonga, about 5 miles west of Tallangatta, and is identical with the Tin Hut reef shown on the geological plan of this parish.

The surface and oxidized zone of the Tin Hut reef and most of the lines constituting this belt were worked nearly 50 years ago, and abandoned as valueless when the sulphide ore was reached. Very little reliable information is obtainable regarding the old workings.

The accompanying ground plan and section show the relative positions of the old Tin Hut workings and the adit level now being driven. The original work was carried out from a series of shafts and surface stopes

extending over a length of nearly 300 feet. The main shaft is said to be down 110 feet with sulphide ore coming in at about 70 feet. There is not sufficient evidence to show whether there was one continuous shoot.

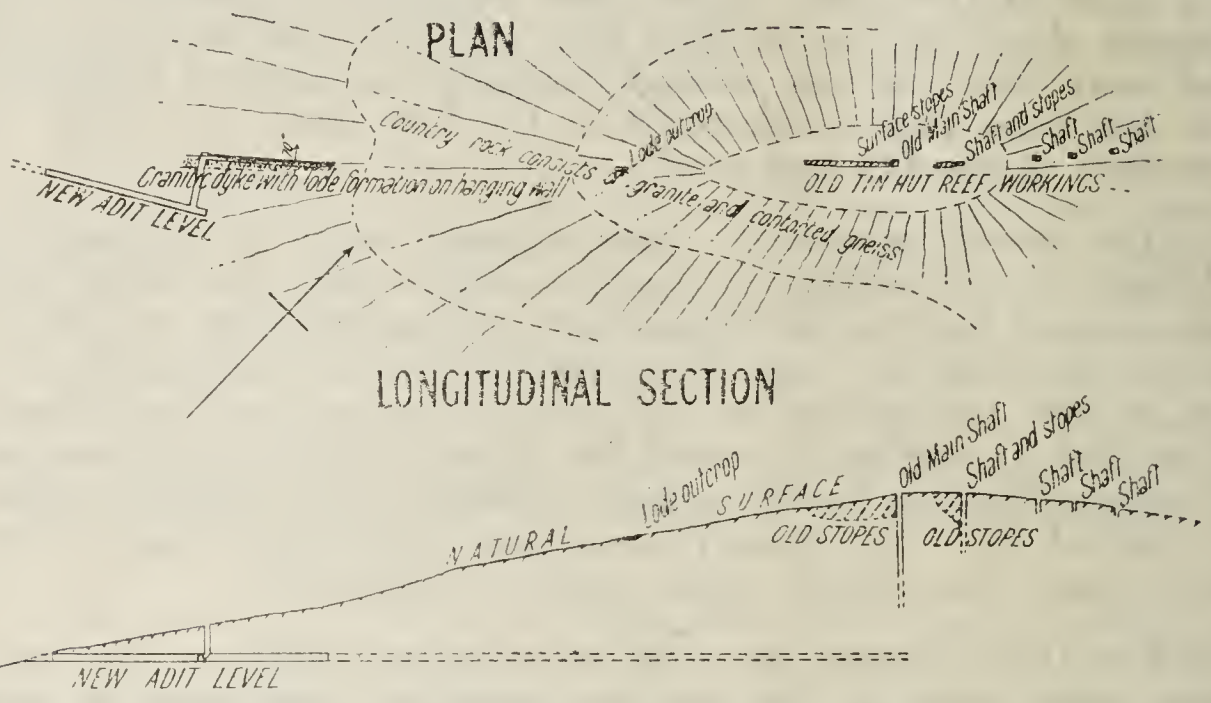


Fig. 107. Plan and section, Glengarry Mine.
Scale : 300 feet to 1 inch.

The lode is said to have been about 2 feet wide, and Mr. Northy, the present manager, has informed me that he remembers the first crushing from this mine yielded 6 oz. of gold per ton.

The present company has intersected the lode and driven along it for a distance of 75 feet. The lode is an oxidized formation on the hanging wall of a highly micaceous granitic dyke, and ranges from 18 to 24 inches in width. At 55 feet along the lode a decomposed black pyritic ore body appeared in the bottom of the drive, and continued for about 15 feet, but had given out in the face at the time of my inspection; it appeared to be chiefly arsenopyrite. The present face is only about 15 feet from the surface, and consists of oxidized dyke formation with no sulphide.

The manager informs me that he can get good prospects of gold in the oxidized gangue, and the geological indications are certainly favorable. The drive along the lode will prospect the line thoroughly.

The information and evidence available are not sufficient for a reliable opinion to be formed as to the lengths or persistence of the pyritic ore bodies; still it is reasonable to consider that they will persist in depth and that they are worth testing.

Two typical samples of the gangue gave the following results on assay:—

472. Pyritic ore, Glengarry Mine.
473. Gangue, Glengarry Mine.

——	Gold per Ton.			Silver per Ton.			Arsenic.
	oz.	dwt.	gr.	oz.	dwt.	gr.	%
472	3	9	6	1	7	10	19·3
473	1	10	1	0	15	0	3·5

TATONG ANTIMONY AND GOLD MINE, TATONG.

By J. C. Grieve.

About 30 years ago a lode about 5 feet in width, striking N. 60° W., and underlaying approximately 65° from the horizontal to the south, was discovered traversing the ridge of a steep spur rising from Holland's Creek towards Toombullup.

As a result of prospecting along the outcrop, the early miners discovered bunches of stibnite occurring in the quartz lode matrix for a distance of about 50 feet. A vertical shaft was then sunk in the metamorphic country rock, and at a depth of about 80 feet a cross-cut of 20 or 25 feet was driven north-easterly, and cut the lode, which was followed probably 30 feet west and stoped upwards, but not to the surface. Thirty tons of first class stibnite are stated to have been mined and the mine was abandoned until about 1914, when a party located an adit level, about 400 feet to the west of the 80-ft. shaft, and about 100 feet below the collar of same. This adit was driven about 250 feet (in hanging wall country) parallel with the lode, and then a cross-cut of 30 feet was put out, which cut the ore channel.

Bunches of stibnite were found making to the west, and were followed for about 20 feet, and winzed to 30 feet below adit. About 15 tons of clean stibnite were credited by this effort, and work again ceased until the present company resumed work by sinking the winze a further 10 feet and underhand stoping for 30 feet to the west below old stopes.

No ore of value was found in the 10 feet of winzing referred to, but a bunch containing about 2 tons of fairly clean stibnite was found and mined below the old stopes. This bunch of ore was not continuous downward, and apart from a few small and valueless veins of stibnite through lode matrix, there is no ore visible in the mine at present.

In regard to future prospecting, from particulars ascertainable the chute of ore worked from shaft in the early days is pitching at about 60° from horizontal towards the winze in adit. It appears probable that other bunches of stibnite might be located if the adit level were extended about 130 feet towards the old shaft and along the lode channel, and, as it would be costly to reopen the old shaft, the extension of adit would be the least costly and best method of prospecting for further ore bunches. From past records of these ore bunches, the quantity of ore obtained was small, and it is doubtful if any further bunches will be found appreciably larger until a much greater depth is reached, and possibly not then.

The lode and country rock is hard, and likely to lead to high mining costs. The 130-ft. extension suggested will probably cost about £3 per foot.

Unlike Costerfield district, no other parallel lodes have been discovered in the vicinity of the Tatong Company's ore channel.

After taking into consideration (i) the high cost of locating and mining these when found, (ii) the small size of ore bunches, (iii) the cost of transport to railway and thence to treatment works, and (iv) the

inappreciable gold values, I am very doubtful if any financial success would be gained by continuing mining on this portion of the company's lode.

The company might be successful in locating a further deposit of ore if prospecting were continued along the lode outcrop by shallow trenches. Two men could be utilized at this work for three months, or longer if good prospects warranted.

[24.11.21.]

REEFS AT QUEENSTOWN AND PANTON HILLS.

By O. A. L. Whitelaw.

The main lines of reef in the Queenstown and Panton Hills mining districts were examined in connexion with the application of the local Progress Association for the use of a diamond drill to test the downward continuation and value of the reefs at a depth.

During my visit I examined on the surface and, where practicable, underground the following lines of reef:—Homeward Bound, Buck, Moonlight, Swedish, Gurlach's, and Lancashire Lass, at One Tree Hill; Barker's, Murray's, and Russel's, at Yow Yow; and the Jenny Lind and Orams or Panton Hills reef at Panton Hills. Other isolated lines of reef occur, but those that have proven most productive are included in the above group.

One Tree Hill.

The One Tree Hill group of reefs is situated 3 miles S.E. of the township of Queenstown, and has been worked since 1864, yielding very rich returns in the higher levels. The Buck reef, strike N. 28° E., dip in adit 60° E.; Moonlight reef, strike N. 38° E., dip 50° W.; and Swedish reef, strike N. 1° E., dip 55° W., have been worked from open stopes on the surface to an adit driven from Fern Tree Creek about 250 feet below the cap of the hill. In the adit workings the Buck reef, which is in contact with a diorite dyke, is about 3 feet in thickness, the Moonlight 1 ft. 6 in., and the Swedish 2 feet, and all are going strongly underfoot. The influence of the dyke on the size and value of these reefs is well worth more detailed investigation.

Some idea of the gold values of these reefs may be obtained from the incomplete list of crushings appended.

The Homeward Bound line of reef is N.W. of the above, and is at present being prospected by Messrs. Clarke and Connolly. The shaft is about 100 feet deep, and has been sunk on or close to a 6-in. vein of

quartz, which is almost vertical, and strikes N. 5° E. This vertical cuts through, and also faults, numerous slightly inclined veins of laminated quartz which pitch south from the south end of the shaft and north from the north end of the shaft. The workings seem to be right on the crown of a dome-shaped anticline. The gold values are mainly in the vertical, and enrichment apparently occurs along the contact with the horizontal veins. The value of the stone is indicated by the returns below.

To the north-west of the Homeward Bound shaft, and on the north side of One Tree Hill, about 200 feet below the crown of the range, an adit known as Gurlach's has been driven to cut the One Tree Hill reefs on their northerly extension beyond the open stopes. The Swedish reef appears to have been cut, but is extremely small, and has probably been intersected over the north-pitching lens of stone about 2 feet thick to be seen in the Fern Tree adit workings. At the end of the cross-cut an auriferous reef, believed to be the Moonlight, has been cut, but I was unable to make a proper examination, as the face holes had just been discharged. The broken stone at the dump shows gold freely. A Melbourne company is at present exercising an option over this ground.

The Lancashire Lass line of reef, situated between Gurlach's and the Homeward Bound, yielded to 20 oz. per ton to shallow depths, where it appears to have been faulted by one of the horizontal veins similar to those showing in the Homeward Bound shaft.

Yow Yow.

The Yow Yow reefs, 1½ miles east of Queenstown, occur in the mass of the Yow Yow diorite outcrop, or in the disrupted Silurian rock adjacent to it. The conditions are somewhat similar to those of the Wood's Point-Gaffney's Creek dyke-basins. The two reefs I was able to examine were Barker's and Murray's. The former is some distance out into the Silurian rocks, and has been opened up by an adit, and on the crown of the spur, by a 200-ft. shaft. The reef is about 3 ft. 6 in. thick on the bedding. The strike is N. 56° E., and the dip 60° easterly.

Murray's reef is about 6 inches thick, strikes N. 30° E., and dips easterly. It is almost on the dyke-slate contact, and has been worked by means of shafts. Russell and party are now driving an adit to cut these reefs below the worked ground. The tonnage and yields from these and other reefs worked are appended.

Panton Hills.

Several lines of reef have been worked at Panton Hill, but easily the most important is the Oram's or Panton Hill line, on the east slope of the range just below Panton Hills township. This reef is from 6 inches to 12 inches thick, strikes N. 16° E., dips 1 in 4 W., and has been worked to 300 feet in depth along a surface line of one-third of a mile. The stone was consistently rich throughout its course. At Chinaman's Gully the northern portion of the reef was faulted west by a cross-course, thus making two shoots of gold. Water was encountered at 250 feet, but at two points the reef was worked below that level. At 300 feet the reef seems to have been displaced by one of the numerous slides indicated on the accompanying section. In Oram's shaft a cross-cut was put out 300 feet westerly without cutting the underlying faulted section.

From what information I can gather, it seems probable that the reef has been again thrown east, as in the case of the upper slides. I am

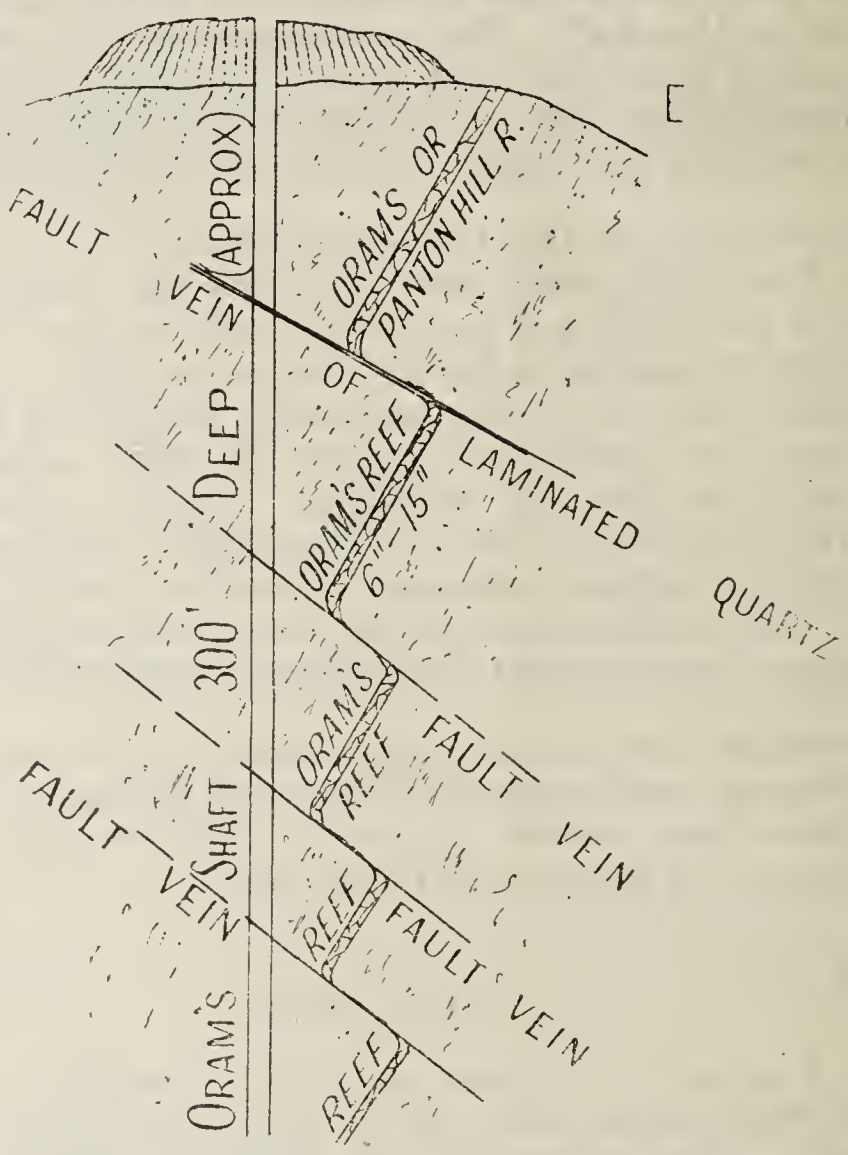


Fig. 108. Sketch section, Oram's or Panton Hill Reef.
Scale : 90 feet to 1 inch.

indebted to Mr. P. P. Plunket, who sank or worked in many of the shafts on this line, for the information shown on the section.

Remarks.

With reference to the Progress Association's application for a diamond drill to test the downward conditions of the lodes, I think this method of prospecting would be extremely risky, and probably useless. In the case of Oram's reef, a glance at the accompanying section will indicate the risks attendant thereon. Had a bore been put down vertically at the shaft site, Oram's reef would not have been cut as far as mining has proceeded; had the bore been put 25 feet east of the shaft, it is possible, on account of the arrangement of the faults, that the reef may have been cut in five different places above the 300-ft. level

Further, there are the large number of "cutting-reefs," or slightly inclined and usually non-auriferous veins. It would be almost impossible to distinguish between these and the auriferous verticals when cut in a bore, and confusion would certainly result. Yow Yow and One Tree Hill are unsuitable for boring, on account of the highly inclined angle of the reefs and the constant occurrence of horizontal veins and reefs.

In my opinion, the only effective method of prospecting the reefs to greater depths would be, in the case of the Oram's and the Yow Yow reefs, to deepen the shafts and to put out therefrom exploratory drives; and in the case of the One Tree Hill adit workings, to sink winzes on the

Buck, Moonlight, and Swedish reefs, and to extend levels therefrom. The available evidence justifies sympathetic consideration being given to any workable scheme that may lead to the opening up of the reefs.

The following are some of the results of crushings from the above reefs since 1864:—

Line of Reef.	Claims or Parties.	Ore Crushed.	Gold Won.
		tons.	oz.
One Tree Hill Group ..	Buck	52	54
	Horns	4,504	2,302
	Homeward Bound	91	811
	Hoit and Dodgin	11	38
	Allen's (Yorkshire Lass)	8	92
	Swedish (Lancashire Hero)	125	1,009
	Swedish (Mystery)	256	186½
	Back Reef	63	97
Yow Yow	Barker's	174	1,103
	Eureka	357	1,205
	Evans	4	14
	German	16	167
	Hartley	19	14
	Hilton	21	40
	Honan	46	40½
	Eureka, Comet, Star	103	112½
	Miller's	456	275
	Mueller	155	142
	Murray	326	499
	Never-Can-Tell	24	109
	North Star	4	27
	Otis	277	338
	Perseverance	31	169
	Prince of Wales	418	77½
	Comet, Eureka	41	88½
	Richards	150	250½
	Simpson's Antimony	92	68
	Clarke	55	85½
	Columbia	691	125
	Comet	183	340
Oram's or Panton Hill ..	Hansen	10	10
	Neill	186	219½
	Nickenson	125	190
	Longley, Millar, Adams, Carter ..	438	1,206
	Phœnix	61	242
	Voght	111	130
	Carter	11½	112

[13.11.19.]

SWEDISH REEF, ONE TREE HILL, QUEENSTOWN.

By J. P. L. Kenny, B.C.E.

On One Tree Hill three lines of reef were discovered and worked in 1859, and the present owners have located a fourth reef—named the Mystery—which does not outcrop. In order from west to east the reefs are the Swedish, Moonlight, Mystery and Buck lines. Some rich yields were obtained from these reefs by the original owners,[1] but

[1] *Vide* Records Geol. Surv. Vict., Vol. IV., Part 3, p. 263.

complete returns are not available. The workings on the hill include shafts on the various lines, with the present working adit from the western side of the hill; also a short adit and a lower main adit from the eastern side of the hill. The various workings on the lines are shown on the accompanying plans. The western (No. 1) adit was originally driven for the Swedish reef and cut it at 337 feet. In driving south the reef was cut off by a fault at 50 feet, and the line has not been located in the level beyond the fault. The plan of the surface workings indicates that the reef has been heaved to the west on the south side of the fault. The drive was continued to a point 200 feet south of the cross-cut where a reef track was cut dipping 72° north-west; this may be the Swedish line, but as the reef has been worked to below the No. 1 level from the No. 3 adit, it is not advisable to do any work here. From this reef track a cross-cut east intersects the Moonlight line at 165 feet. Short drives north and south on the line with a total length of 40 feet did not reveal payable stone. The shoot on the Moonlight reef is 400 feet long on the surface, and the extent of the stopes is not known; the reef does not appear to have been worked from the No. 3 adit level. The No. 1 level cross-cut intersects the reef near the centre of the shoot on the surface, and the drives should be extended north and south to further prospect the reef.

In extending the cross-cut east to intersect the Buck reef, the new find, named the Mystery reef, was cut at 50 feet from the Moonlight line. The reef has an average width of about 6 inches, and drives have been extended 30 feet north and 90 feet south along the line. To the north the course of the reef suggests that it will junction with the Moonlight line at about 35 feet from the face. Should these lines intersect, it is not unlikely that payable stone will be found at the junction; the extension north of the drive on the Moonlight line as already suggested would also test this.

The Mystery reef is intersected by a fault dipping north which heaves it 20 feet to the east on the south side of the fault. A decomposed dyke 1 foot wide also intersects the line, but does not appear to have had any influence on the gold contents of the reef. From the Mystery line a cross-cut east intersected the Buck reef at 28 feet, and from the top of the stopes above the level a cross-cut west broke through into the old stopes on the Moonlight line at 40 feet from the Mystery reef. The shoot on the Mystery line was 100 feet long over the adit level and was worked to a height of 80 feet above that level. The shoot did not go to the surface, but became poor within 25 feet of it. Below the level a winze 56 feet deep has been sunk, and from the winze a drive north of 51 feet shows payable stone in the face; the reef between this drive and the adit above is now being stoped. In the bottom of the winze a wall has been cut dipping 46° north; this may prove to be a fault cutting off the reef, and if so the line will probably be found again a few feet to the east. From the Mystery reef, between December, 1918, and the present date, 152 tons of quartz have been crushed for a return of 440 oz. 2 dwt. of gold, an average of 2 oz. 18 dwt. per ton.

In stoping the reef rich patches showing gold freely are occasionally struck. The Mystery Reef has maintained its width and value to the present depth, 160 feet from the surface; the last crushing of 15 tons yielded 42 oz. 5 dwt. of gold. The policy for the future working of the reef is a matter for immediate consideration.

Plate N.º LIV.

SWEDISH REEF

ONE TREE HILL, QUEENSTOWN

Scale – 80 Feet to 1 Inch.

REFERENCE

Heights above mouth of No. 3 Adit thus 203·6, Strike and dip of strata 37, Quartz veins, Contour Interval-25 feet.

J. P. H. Penny B.C.E.
3·7·22
Revised 31·1·24.

GEOLOGICAL SURVEY OF VICTORIA
W. Baragwanath Director
A. H. Merrin, Secretary for Mines
The Hon. C. L. Goudie, M.L.C., Minister of Mines

PLAN

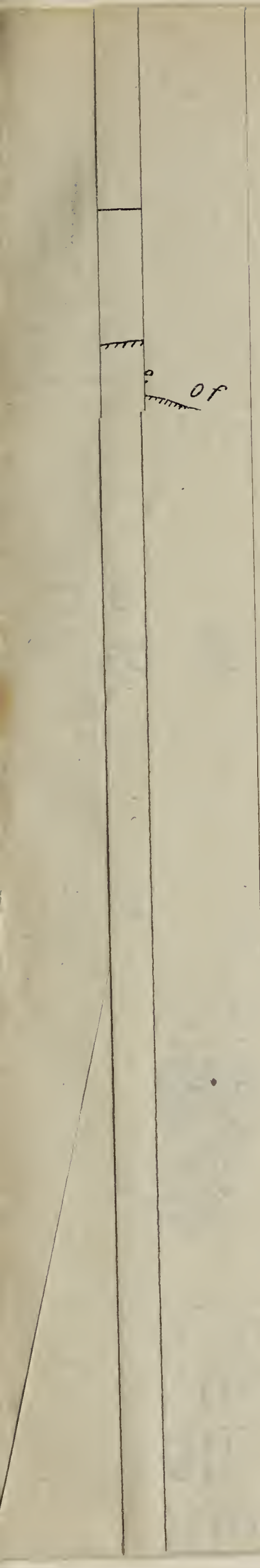
Lease 7525
Castlemaine

Magnetic Meridian

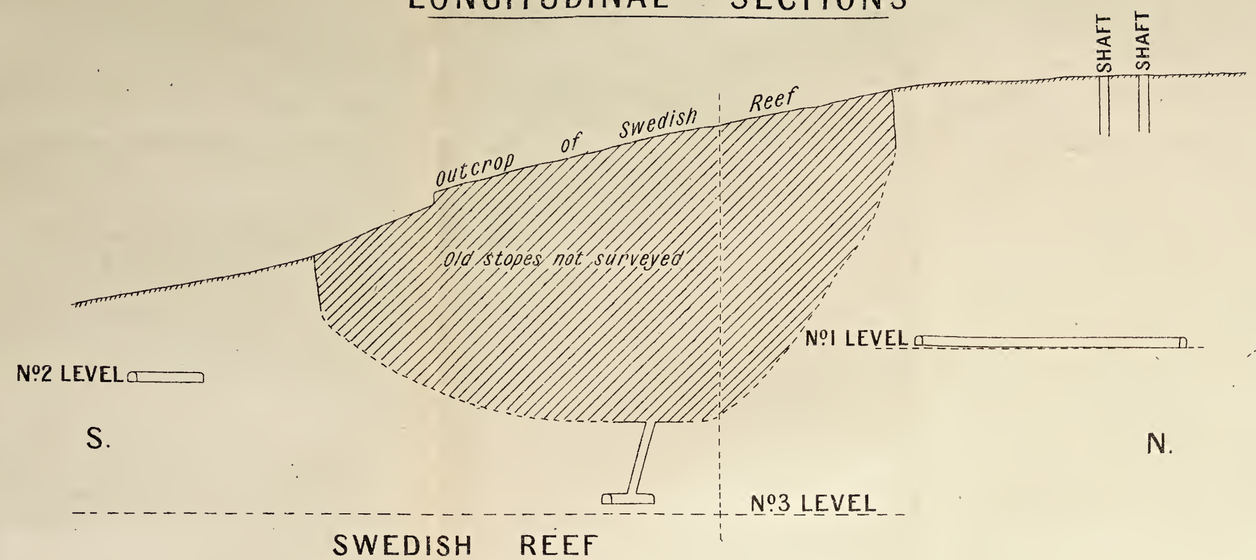
No. 2 ADIT LEVEL
No. 3 ADIT LEVEL
No. 1 ADIT LEVEL
TRANSVERSE SECTION A-B LINE
Drive on Swedish Reef
OUTCROP OF SWEDISH REEF
Drive on Buck Reef
OUTCROP OF BUCK REEF
OUTCROP OF MOONLIGHT REEF
ROAD ON SPUR
Vertical Shaft
Shaft
Fault
Dyke
WINZE
REEF
PROBABLE MYSTERY REEF
MOONLIGHT R.
MYSTERY REEF AT No. 3 LEVEL
MYSTERY R.
BUCK R.
XCut
QVI
RISE

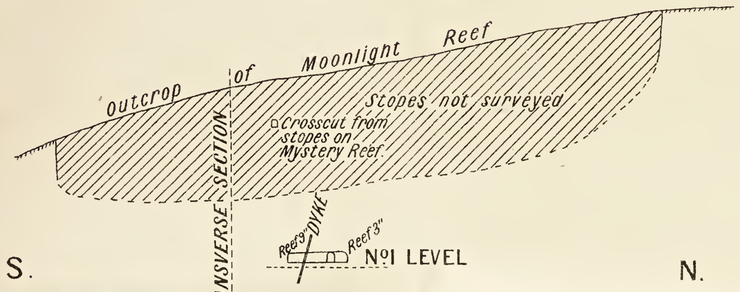
LONGITUDINAL SECTION ON MYSTERY REEF.

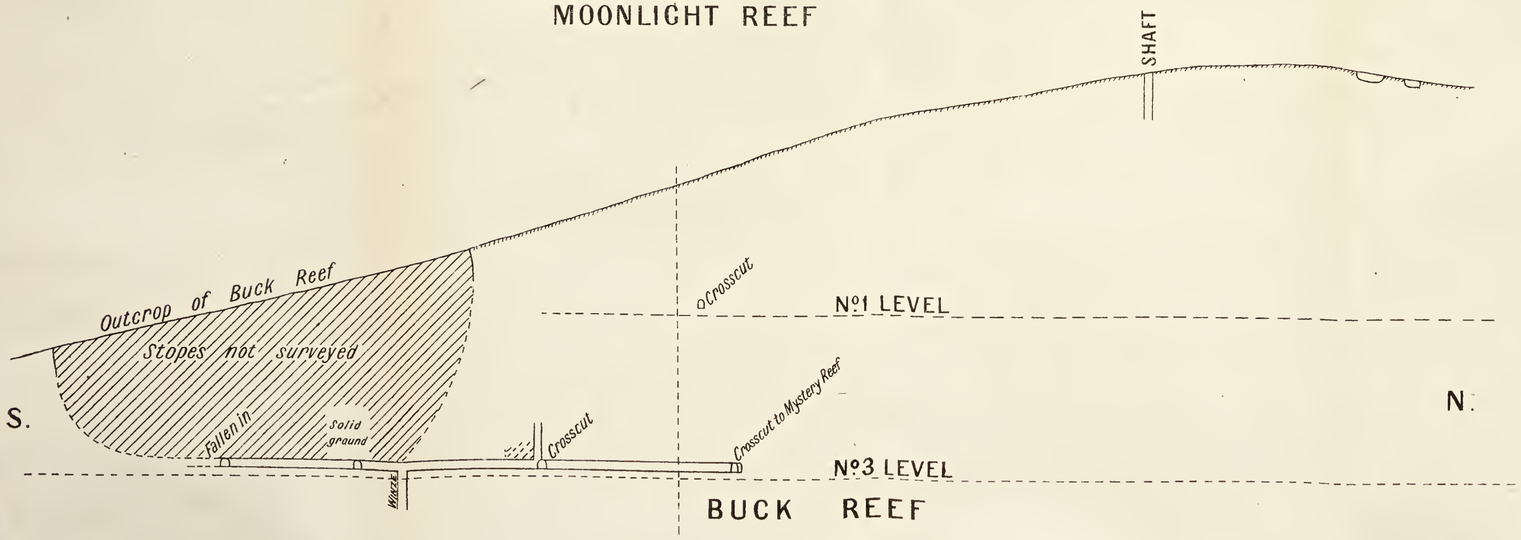
Surface Line
XCut to Moonlight R.
Fault
Dyke
No. 1 ADIT LEVEL
54' INTERMEDTE LEVEL
No. 3 ADIT LEVEL
207'

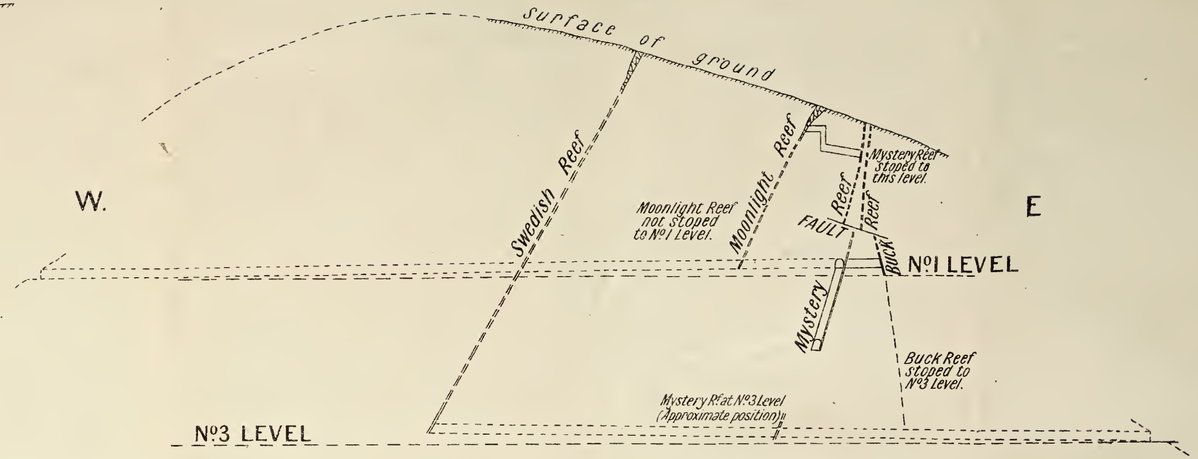

of

LONGITUDINAL SECTIONS









TRANSVERSE SECTION A. B.

Sections
—Swedish Reef—
— One Tree Hill, Queenstown —

Scale, 1"= 80'

GEOLOGICAL SURVEY OF VICTORIA
W. Baragwanath, Director.
A. H. Meyne, Secretary for Mines.
The Hon. C. L. Goudie, M.L.C., Minister of Mines.

G.H. Berry B.C.E.
3.7.22

The No. 3 level from the eastern side of the hill is 109 feet below the No. 2 level, or 51 feet below the bottom of the winze on the Mystery Reef. What is probably the Mystery line was cut in the No. 3 adit level 15 feet west of the Buck Reef. A winze 40 feet deep was sunk on this line and payable stone is said to have been obtained. The line is again cut at a point 90 feet to the north at the No. 3 level, in a cross-cut west off the drive on the Buck reef. The line here carries 18 inches of quartz, and from this point a drive north of 207 feet on the line would give 51 feet of backs below the bottom of the winze on the Mystery reef from the No. 1 level. This drive would prospect the reef along its course, allow of economical working of the shoot above it, and also give facilities for a winze below its level if required.

Taking all the circumstances into consideration, I think the company would be justified in driving this level. The Buck reef has been stoped on the surface for a length of 300 feet; the No. 3 adit intersects the reef at 230 feet from its mouth; a drive north on the line is open for a length of 100 feet, and drives now fallen in were extended both north and south of this. The reef has been stoped from the surface to this level, a maximum depth of 150 feet, but does not appear to have been worked below it. From the end of the open drive north on the Buck reef a cross-cut has been driven north-westerly. The Moonlight reef does not appear to have been intersected in this cross-cut, but the Swedish Reef was cut at 280 feet, and from the level a rise of 75 feet gives access to the bottom of the old stopes.

If the Mystery reef maintains its value at a depth and prospecting work on the other lines reveals further bodies of payable quartz, the question of sinking a main shaft to test all the lines at a greater depth should receive consideration.

[5.7.1922.]

The following additional notes upon the Swedish reef mine at Queenstown are based upon a survey by Mr. J. W. Binney of the No. 3 level workings recently opened up.

Following upon my previous report work was started at the No. 3 level. The drive north on the Buck reef was cleaned out and found to extend 255 feet north-easterly from the westerly cross-cut to the Swedish reef. From the face of this drive a cross-cut extended westerly for 50 feet. This cross-cut was continued for 15 feet further west, and the Mystery reef was cut at 65 feet from the Buck line. Drives have been extended 17 feet north and 11 feet south on the Mystery reef, which has an average width of 15 inches, and is estimated to be worth 12 dwt. of gold per ton.

The south drive on the Mystery reef at the No. 3 level should be continued a further distance of 41 feet, and then a rise of 50 feet on the reef at this point would connect with the winze from the No. 1 level.

The Mystery reef could be further prospected at the No. 3 level by extending a cross-cut west from the drive on the Buck reef at a point about 150 feet north of the cross-cut west of the Swedish reef. A cross-cut west of about 35 feet would intersect the Mystery reef at this point. On the No. 3 level a cross-cut west of about 60 feet from the Mystery reef should intersect the Moonlight line and prospect it at this level. A suggested extension of the No. 3 level to the western side of the hill is not, in my opinion, advisable, as the advantage to be gained would not justify the outlay necessary.

For the present the work of making a connexion with the No. 1 level should be pushed on. When this is completed a winze should be sunk below the No. 3 level to prove the value and extent of the ore available. If developments were satisfactory a five-head battery could then be erected at the old battery site on the western side of the hill.

[13.2.23.]

THE SUGARLOAF RESERVOIR BASIN, GOULBURN RIVER.

By J. P. L. Kenny, B.C.E.

The Sugarloaf Reservoir Basin in its final stage will extend from the junction of the Goulburn and Delatite Rivers up the valley of the former to the Howqua River, and up the latter to Howe's Creek, taking in portions of the valleys of Jerusalem Creek and the Big River, tributaries of the Goulburn, also Brankeet Creek, and Ford's Creek, tributaries of the Delatite. When the embankment is carried to its final stage, a height of 145 feet above the river bed, an area of 16,249 acres, or over 25 square miles of country, will be submerged and the capacity of the reservoir will be 918,100 acre feet. The geology of this area is the subject of this report.

The site of the embankment, just below the junction of the Delatite with the Goulburn River, is almost ideal from an engineering point of view. On the west bank of the river rises Sugarloaf Hill, a conical peak of indurated Silurian sand-stones and mud-stones, giving a solid foundation for the spillway and the abutment of the dam, while on the other side of the river the bedrock rises more gradually to Pinniger's Hill, on which the eastern end of the embankment rests. The foundations are carried down to bedrock for the length of the wall, and reach a maximum depth of 75 feet below the river level.

The shape of the basin to be inundated is roughly that of a capital C with the embankment in the middle of the convex side. Just above their junction the Delatite and Goulburn Rivers are flowing in diametrically opposite directions; they unite and turn sharply south at right angles to their original courses. The explanation of this unusual feature is to be found in the history of the physiography of the Goulburn River. This subject has been dealt with by Fenner[1], who suggests that the original Goulburn River flowed north, its former outlet being the present Broken River Valley. The Goulburn flows in a north-westerly course to Fry's Bridge, and then turns sharply to the south-west. To the north of Fry's Bridge a low saddle, known as Brack's Gap, separates the Goulburn and Delatite Valleys; west of this saddle the divide rises again into a steep-sided range. Fenner suggests that originally the Goulburn flowed through this gap down what is now portion of the Delatite Valley and up the present valley of Brankeet Creek, to the Broken River Valley near Barjarg.

My observations tend to confirm this view. I found water-worn and polished pebbles on the saddle at Brack's Gap, similar to material showing in the Goulburn Valley above the Gap, and the wide valley of Brankeet Creek must have been carved out by a more powerful denuding agent than the present creek.

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[1] *Physiography of the Mansfield District*, by Charles Fenner, B.Sc. *Proceedings of the Royal Society* Vic., Vol. XXVI. (n.s.), 1913.

The present courses of the Goulburn and Delatite Rivers are probably due to fault movements which have altered the original courses of the rivers, and incidentally provided an almost ideal reservoir site.

Further evidence of changes in the river courses is to be found at a spot three-quarters of a mile east of the junction of the Goulburn and Big Rivers. An old river bed can be traced here for over half-a-mile in length; the channel, which is without doubt an old course of the Big River, is 80 feet above the river flats at the junction.

Geology.

The bed-rock in the area consists of Silurian slates and mud-stones, with an occasional bed of conglomerate. A collection of fossils was obtained from the weir excavations on Sugarloaf Hill, and fossiliferous conglomerates occur at Jerusalem Creek on the west boundary of Allot. 6c, Thornton, and on the Big River near the south-east corner of the Darlingford township reserve. The beds are regularly folded and the axial lines strike N. 30° W.

On the Howqua River, a mile above its junction with the Goulburn, an outcrop of slate, possibly of Ordovician age, occurs in the river bed.

Intrusive dykes penetrate the Silurian beds. At the junction of the Howqua and Goulburn Rivers a fine-grained quartz porphyry dyke 60 feet wide outcrops on a low spur which diverts the Howqua River to the south before it junctions with the Goulburn. A similar bend to the south in the Goulburn River just above the junction may be due to the resistance of the same dyke. A diorite dyke similar to those of the Wood's Point belt outcrops in the north-west corner of Allot. 7 of A, Parish of Howqua West. The dyke bulge is apparently about 300 feet wide, and 20 feet from its eastern edge a vertical quartz reef 18 inches wide outcrops. A tunnel has been driven 30 feet on the reef which has a strike of 143°, but apparently the quartz carries no gold.

Outcrops of impure vesicular limonite occur in places usually only a foot or two in thickness and agreeing in strike with the country rock. The limonite is reddish brown with yellow vesicular spots, and the outcrops may be the capping of dykes.

Below the junction of the Howqua and Goulburn rivers extensive deposits of Older Pliocene conglomerate occur on both sides of the latter. The conglomerate is composed of subangular and rounded fragments of chert. quartz and sandstone. Some of the pebbles show a high polish, and the formation may be partly of glacial origin. As already mentioned, this conglomerate extends to the top of the Goulburn-Delatite divide at Brack's Gap.

Bordering the valleys and occupying numerous basins along the river courses terrace deposits of sand, gravel, and clay occur, reaching a height of 150 feet above the present valley.

The present river flats, usually about half a mile in width, consist of recent sand and gravel. Occasionally beds of recent cemented conglomerate occur in the valleys, and on the Delatite River $2\frac{1}{2}$ miles above its junction with the Goulburn a little gold has been won from such a deposit.

Mining.

Old alluvial gold-workings are to be seen within the basin in several places. On Wilson's Creek the ground has been worked to within half a mile of its junction with Jerusalem Creek. On the Goulburn River

the bed of the stream was dredged from just below Fry's Bridge to a point 2 miles higher up, but the returns were not remunerative. On the Delatite River some recent fossicking has been carried out at a spot 2½ miles above its junction with the Goulburn, and in allotment 14 of 28, Parish of Howqua West, old shafts along the course of a gully indicate that an alluvial run was worked here. The diorite dyke outcropping in Allotment 7 of A, 1½ miles to the north-west, may be the source of the alluvial gold in this gully. On the east bank of the Delatite River and north of Allotment 6 of A, Howqua West, a considerable amount of sinking and tunnelling in a heavy water-worn gravel was done by one man within recent years, but as far as I could learn little or no gold was obtained. A little higher up the Delatite old alluvial workings are to be seen in Italian Gully, 1½ miles from the river. I was informed that payable returns were obtained here.

The Sugarloaf Reservoir Basin will extend up Brankeet Creek to within half a mile of the junction of Dry Creek. The watershed of this creek includes the Tallangallook Gold-field, and the creek was closely worked for alluvial gold in the early days of gold mining. In 1910, the Collegian bucket dredge started work near the mouth of the creek and worked up-stream for about 4 miles. The record of this dredge is as follows:—

Year.	Gold Won.	Area Dredged.	Average Depth.	Gold per Cubic Yard.	Working Period.	Amount Dredged per Week.	Gold per Week.
	oz.	acres.	feet.	gr.	weeks.	cub. yds.	oz.
1910 ..	893	10·0	11·3	2·3	36	5,064	24·8
1911 ..	819	10·5	12·1	1·8	33	6,029	23·7
1912 ..	1,181	13·5	15·0	1·7	41	7,970	28·8
1913 ..	863	12·0	12·8	1·6	46	5,401	18·7
1914 ..	1,892	12·5	15·0	3·1	44	6,684	42·8
1915 ..	1,378	11·5	14·4	2·4	44	6,142	31·3
1916 ..	1,280	11·0	14·8	2·3	46	5,751	27·8
1917 ..	1,190	12·0	15·5	1·9	48	6,251	24·7
1918 ..	269	8·0	16·0	0·6	36	5,736	7·0
1919 ..	538	6·5	16·0	1·5	23	7,295	23·0
1920 ..	533	8·0	15·0	1·3	28	6,914	19·0
1921 ..	174	3·0	12·0	1·4	11	5,280	15·0

The total yield of gold was 11,012 oz., and £3,900 was paid in dividends.

On the Brankeet Creek a lease has recently been taken up by the Maori Queen Gold Dredging Company. The company's lease extends downstream from the Junction Pre-emptive Right, three-quarters of a mile below Dry Creek. The company reports that prospecting shafts gave values up to 6 gr. per cubic yard. The ground on Brankeet Creek appears to consist largely of sand highly suitable either for bucket dredging or hydraulic sluicing. If the ground maintains an average value of 3 grains per cubic yard with a depth of 12 feet or more, it should be profitable for dredging.

Deep Leads.

Deep ground follows the courses of the Goulburn and Delatite Rivers, and it has been suggested that a payable lead may exist. The deepest ground at the weir site is about 70 feet, and the bedrock in the Goulburn and Delatite Valleys will be at this depth or possibly deeper. It has been established in deep lead mining that payable

alluvial gold does not as a rule extend far from the auriferous belt which shed it, and as far as the Goulburn and Delatite Rivers are concerned, there is no auriferous country within the Sugarloaf Basin area. The lower portion of the Big River has not been worked for alluvial gold, and on Wilson's Creek (a tributary of Jerusalem Creek) the lowest workings are 1 mile from the Goulburn River, and it is not likely that this creek has enriched the main valley. The Goulburn River passes through a belt of auriferous country above the junction of the Howqua River. To determine if a deep lead exists in the Goulburn Valley within the area to be submerged, a line of bores might be put down across the valley at a point about half a mile below the junction of the Howqua with the Goulburn.

In the valley of Brankeet Creek a deep lead may be found. The auriferous gravels and sands of Dry Creek may be expected to continue down the Brankeet Creek Valley. The creek flows in a wide open valley, and a line of bores across it would determine if deep ground exists, and would also give an indication of the value of the overlying material. A suitable site for a line of bores would be a short distance south of the Junction Pre-emptive Right. The site would be about 1 mile below the junction of Dry Creek, and if prospects here were favorable, the valley could then be tested down to the Delatite River.

The valley of the Delatite River above Brankeet Creek is not likely to contain a payable deep lead, as the watershed of the river above this point is almost entirely in non-auriferous country.

[6.4.23.]

NEW DEMPSEY'S MINE, GAFFNEY'S CREEK.

By O. A. L. Whitelaw.

This company's workings are situated in the valley of Gaffney's Creek, about half a mile above its junction with Raspberry Creek, and immediately below the confluence of Ryan's Creek. The area of ground held under lease consists of 31a. 0r. 5p.

As is usual in this belt of country, the gold is found associated with dioritic dykes intruded into Silurian beds of the Walhalla series, and along points of contact of or in close association with, the dykes and quartz fissure bodies. The quartz lodes are in all cases of more recent age than the dykes.

Two main dykes exist in the Dempsey's workings, known respectively as Hunt's, and the Little dyke. Hunt's is the most westerly and varies in width from 1 foot to 8 feet. The average dip is 83° west. The Little dyke is parallel with, and from 80-120 feet east of Hunt's, and has approximately the same underlay; its average width is 2 feet.

Despite the proximity of these two dykes, they preserve their parallelism over a great distance, certainly not less than 12 miles.

Numerous shoots of gold have been worked along their course, notably on the south in the township of Wood's Point, and in such mines as the A1, Great Eastern, New Lauraville, and Hunt's, while north the shoots of gold which have been worked so profitably in the Rose of Denmark mine and in the Star of Erin occur in the body of Hunt's dyke. In both latter cases the Little dyke can be observed on the east, but it has not been worked.

In Dempsey's mine Hunt's dyke has been worked as a lode body for the gold contained in its small intersecting quartz veins, but the Little dyke has not been so worked, although it appears to have influenced the gold supply in the fissure quartz veins of the adjacent country rock.

Some small spurs of dyke are known from Hunt's dyke towards the Little dyke, more particularly along the line of a crushed and broken, slightly carbonaceous, belt of slate which lies between the two dykes.

In addition to the dykes mentioned, a true fissure reef known as Dempsey's reef occurs. This lies about 300 feet east from Hunt's dyke, strikes W. 40° N. and dips east at 69°. It will be observed that Dempsey's reef and Hunt's dyke dip away from each other.

Dempsey's reef was discovered under the alluvial workings of Gaffney's Creek and was, in the early days, worked along the surface for a length of 230 feet. Some of the yields are said to have been very rich, but I have no reliable records.

An engine shaft has been sunk near the north end of the shoot of gold; this passed through the reef channel at 60 feet. The deepest level attained (No. 5) is at a depth of 333 feet, the reef at that depth being 104 feet east of the centre of the shaft

The shoot of gold, which averages about 150 feet in length and pitches north at 55°, has continued with fair values from the surface to No. 5 level, and I am informed by the manager that it is still going underfoot. I may here remark that in No. 3 level south, just beyond the southerly termination of the north-pitching shoot of gold, the pitch of the quartz bodies and country rock is distinctly south at 24°, and it should be worth further investigation to ascertain if there are any gold values going south.

From August, 1907, to January, 1910, the present company crushed from these shaft workings 12,188 tons of ore for 4,366 oz. 9 dwt. of gold valued at £15,515 14s. 4d., equal to 7 dwt. 4 gr. of gold per ton.

No. 5 level has been driven north 465 feet from the shaft cross-cut, and, no further shoot of gold being cut, was discontinued. During the last 30 feet of driving the footwall of Dempsey's reef has changed its underlay to 54° E. against 69° E. further south. Should the footwall maintain this underlay Dempsey's reef would intersect Hunt's and its branch dyke near the sill of the inside or winch shaft in the No. 2 adit workings. As will be seen from the cross-section A—B on plan, a solid wall identical in conditions and underlay was cut in No. 1 cross-cut from No. 2 adit. It was in the fractured and broken dyke country above this footwall that the gold values of the inside or adit workings were obtained. Should, however, the wall of Dempsey's reef maintain its underlay of 69°, it would be found 140 feet east from the inside shaft at No. 2 adit. The following sketch taken in the face of No. 5 north level is typical of the mode of occurrence of Dempsey's reef and illustrates the formation of a reef on a footwall which has faulted the strata, and quartz veins falling into the fault reef along the bedding planes.

Hunt's dyke was first worked by means of an adit (No. 1) driven into the western side of the hill at an elevation of 150 feet above the surface or outside shaft. The dyke was stoped out to the surface for the gold contained in the small quartz veins which intersect it. The yields do not appear to have been high. Later an adit cross-cut driven from the level of Gaffney's Creek intersected the line of dyke at 100 feet and

a drive was put in north along the dyke. At 416 feet gold was struck in the dyke body and was followed to 662 feet. The shoot was stoped for an average height of 20 feet over the level, with gold going underfoot in places. Some payable ground is believed to exist underfoot at present. This shoot of gold has not been connected with that worked from No. 1 adit to the surface.

At 758 feet in Hunt's level a cross-cut was put out east, intersecting at 15 feet the east-dipping lode body, which appears to be identical with the wall previously described in the face of No. 5 level from the surface shaft. Just east of this wall payable gold was struck in broken country associated with some small spur dykes from Hunt's dyke. This ground was stoped to a height of 40 feet above No. 2 adit level and for a width of 30 feet. The gold shoot continued over and beyond the winch shaft and was found to be dipping north.

At 800 feet in Hunt's level an engine shaft was sunk from a chamber to command this stone. This reached a depth of 225 feet (inclusive of 17 feet of wall) and levels were extended north at 98 feet and 198 feet. Good values were obtained to below 100 feet in the shaft workings, but as far as I can gather from the plans of Mr. W. H. Cundy, and other information, there was very little gold found at the 200-ft. level. These workings are at present full of water. Crushing from these stopes began in December, 1897, and continued till March, 1907, during which time 19,548 tons of ore yielded 18,008 oz. of gold, valued at £69,189 7s. 3d., an average of 18 dwt. 10 gr. per ton.

At the present time work in Dempsey's mine consists of extending No. 5 level from the surface shaft, on Hunt's dyke, to get under the stopes from the winch shaft. Should the conditions existing in the upper levels be continued downwards, the gold-bearing formation should be struck by extending No. 5 level a further distance of from 100 feet to 300 feet from the face of No. 5 level on Hunt's dyke as exposed on the date of survey, 18th March, 1910.

In conclusion, I beg to state that as the result of the survey the following work appears to be necessary:—

1. To continue the No. 5 level on Hunt's dyke a further distance of 400 feet. The formations met with in the winch shaft may be encountered anywhere between 100 and 300 feet from the face of level (18.3.10). It is an absolute essential that this work be accompanied by at least one cross-cut east for a distance of 100 feet. Should lode formation be struck in the carbonaceous slate belt lying between Hunt's and the Little dyke, it should be carefully prospected.
2. In the event of finding payable stone approximating in value to that in the winch shaft workings, it would be advisable to deepen the surface shaft and to work the lower value stone going underfoot in No. 5 level.
3. Extend a cross-cut from No. 2 adit level either from the end of No. 1 cross-cut or No. 2 cross-cut a further distance of 80 feet. At this point the footwall of Dempsey's reef should be cut, should it happen that the wall showing in No. 1 cross-cut from No. 2 adit at 25 feet is not the wall showing in the face of No. 5 level (Section A—B). This work would in addition be good prospecting, as the cross-cuts from No. 2 adit have not in any case cut through to solid walls.

4. Extend a level south 50 feet below No. 3 level to a distance vertically below the south end of No. 3 level. This work would prove if any gold goes south from the stopes in No. 3 level where the formations are seen to be pitching south (see longitudinal section).

[7.5.10.]

A large amount of work has been done since my last inspection in the way of prospecting, operations chiefly being confined to the extension of the No. 5 level on Hunt's dyke and to underhand stoping Dempsey's reef to the north of the outside shaft below No. 5 level. The latter ground, being the lowest level in the mine, was very wet, but stoping was carried to a depth of 15 feet for 40 feet in length by 3 feet in width. The values were over an ounce per ton and indicate that the gold-shoot is still going down strongly. There can be no doubt that the policy necessary to keep this mine on the gold-producing list is to sink the main or outside shaft at least a further 100 feet to command this shoot of gold.

The north drive on Hunt's dyke has not yet disclosed any payable gold-bearing formation, but at no point along the whole length of the level have the indications been more favorable for the occurrence of gold than in the present face, where 20 or 30 feet of lode formation, associated with the dyke, has been exposed. I quite concur with the manager that this level should be continued a further 100 feet or until such time as the lode material now showing has been driven through. Developments at this point would greatly enhance the value of the mine.

As a subordinate work I would suggest that when opportunity permits, No. 3 level be extended a further 50 feet south, as the pitches of both country rock and lodes are here south—in opposition to the worked portions of the mine where the pitches are north, and it is possible that a gold-bearing shoot may be found in this direction.

[26.1.12.]

The reef workings are situated in the bed of Gaffney's Creek, 30 chains above its junction with Raspberry Creek, and are associated with a small belt of dykes which have produced Hunt's, the A1 and the Morning Star mines on the south and the Rose of Denmark on the north.

Three different lode bodies have been worked in the New Dempsey's mine:—

1. Dempsey's reef.
2. Hunt's dyke, 300 feet west of Dempsey's reef.
3. The Little Dyke with an associated spur reef, which is probably part of Dempsey's reef.

No. 1 or Dempsey's reef is a well-defined body of quartz to 14 feet in thickness striking N.W. and dipping east across the country.

It was discovered during the working of the creek alluvial deposits and worked by claim-holders to about 130 feet in depth. From 130 feet to 330 feet the ground was worked by the present company, who for the period August, 1907, to January, 1910, milled 12,350 tons of stone for 4,366 oz. of gold.

It will be observed from the attached longitudinal section of the stope workings, that an enriched zone occurs in the gold shoot. This has been underhand stoped in the bottom level (No. 5) to a depth of 20 feet and 134 tons of stone crushed for a yield of 173½ oz. of gold. This stope was discontinued owing to heavy water.

The Dempsey's reef workings are extremely wet, the inflow being caused by seepage of surface water through the old stopes. This water should be dammed at either No. 4 or 5 levels and pumping operations carried out from one of these points.

In a previous report (26.1.12) on this mine, I stated: "There can be no doubt that the policy necessary to keep this mine on the gold producing list is to sink the main (or outside) shaft at least a further 100 feet to command this shoot of gold."

I still hold the opinion that the results from the stopes above No. 5 level, together with return of over 1¼ oz. from below No. 5 level, justify further exploration at a depth. The shaft is very badly situated for economically sinking a greater distance than 500 feet from the surface. The reef and gold-shoot are both dipping away from the shaft, and at the proposed new level (No. 6) the reef would be 145 feet east of the shaft, and the gold-shoot 160 feet north of a direct cross-cut.

I estimate the cost of the proposed work to be approximately £2,500. Should the 100 feet of ground below No. 5 level prove of equal value to the 100 feet above, approximately 2,000 oz. of gold should be obtained.

[10.5.15.]

During my recent visit to Gaffney's Creek I examined the latest work done at the New Dempsey's mine.

Operations have been confined to prospecting the upper portions of Hunt's dyke and the beds to the west of it. Results have been disappointing and work suspended.

If the mine is to be rehabilitated, shaft-sinking in the outside shaft should be resumed and Dempsey's reef prospected below where the gold shoot dipped underfoot in No. 5 level.

[30.7.20.]

ELDORADO MINE, GAFFNEY'S CREEK.

By O. A. L. Whitelaw.

The Eldorado mine was visited by Mr. J. P. L. Kenny in May, 1918, and a rise laid out from the South Eldorado cross-cut to intersect the Eldorado shaft at an angle of 44°. This rise has reached a height of 157 feet, and has been temporarily abandoned. Since then the company has driven 110 feet south from the rise, and is still in a full body of dyke, but I do not anticipate the dyke-bulge extending a greater distance than an additional 15 feet to 20 feet. As the end of the dyke-bulge is approached regular quartz reefs are coming into the level, and these are of very promising appearance.

For the first time since operations were commenced by this company the objective indicated in my report of sixteen years ago (Memoir No. 3) has been approached, and the company is reasonably justified in anticipating some return for their expenditure.

When the south end of the dyke-bulge has been intersected, a rise should be put under the capping slates to intersect the reefs which are not cut in driving south. This rise should be at about 120 feet south of the 157 feet rise, and the latter should be abandoned unless required for ventilation purposes.

To eliminate several hundred feet of haulage and conserve a rather scanty supply of air pipes, I would suggest that the company put out a cross-cut 50 feet due west from a point 1,035 feet in from the adit mouth; this will connect their present working face with the main adit level and also prospect the south and south-east end of the dyke-bulge.

[8.10.19.]

ELDORADO MINE, GAFFNEY'S CREEK.

By J. P. L. Kenny, B.C.E.

The north rise after reaching a height of 157 feet was abandoned, and a new rise was started 90 feet to the south on the southern apex of the dyke-bulge. This rise is now up 300 feet on the underlay above the tunnel level. Numerous quartz veins have been intersected in the rise and five quartz floors have been passed through. A floor carrying gold and dipping south was cut at 30 feet in the rise and north-dipping floors were met at 137 feet, 166 feet, 200 feet, and 299 feet. These floors for the most part carry a few inches of quartz, and gold could be seen in the stone on the 137-ft. floor. The floors at 137 feet and 166 feet were prospected by short drives not accessible at the time of my visit. On the floor at 166 feet the mine manager reported 16 inches of quartz in one of these drives. The floor at 299 feet has a strike of 101° and dips 22° north. It carries 1 inch to 4 inches of quartz. The top of the rise, which is 280 feet vertically above the bottom adit level, has now reached a point above the old bottom level, 100 feet below the No. 2 adit level. I consider that a connexion should now be made with the old workings, thereby improving the ventilation, draining the mine and giving facilities for economically prospecting both the floors previously worked and those cut in the rise. There are three ways in which a connexion could be effected:—

1. By continuing the north rise as originally laid out to the bottom of the engine shaft.
2. By driving from the present rise to the level 100 feet below the No. 2 adit.
3. By extending the present rise to the No. 2 adit level and then driving to that level.

1. To make a connexion from the north rise would require an extension of that rise a further 190 feet. This work would drain the old workings, and the rise is well situated for opening out on payable stone as the floors dip towards it.

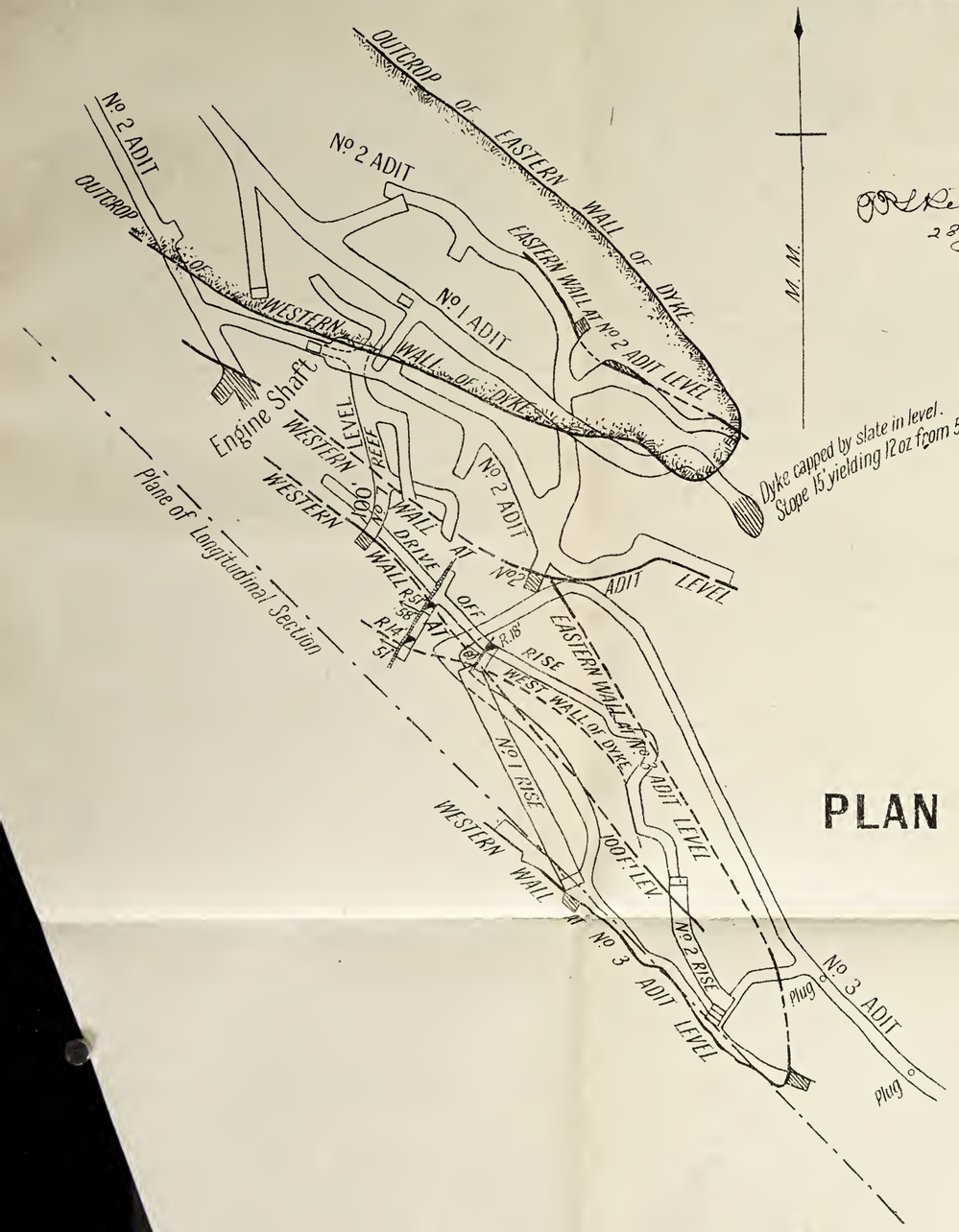
2. By driving north along the western wall of the dyke-bulge from a point 15 feet below the top of the south rise at the time of the survey, for a distance of 220 feet, a connexion will be made with the drive on the No. 7 reef 100 feet below the No. 2 adit level. This drive will prospect the ground still untested and will cut any intervening floors in a favorable zone. The drive would not need to be timbered and the cost would be about one-third the cost of rising the same distance, and I would suggest that this work be taken in hand forthwith.

Plate N°. LVI.

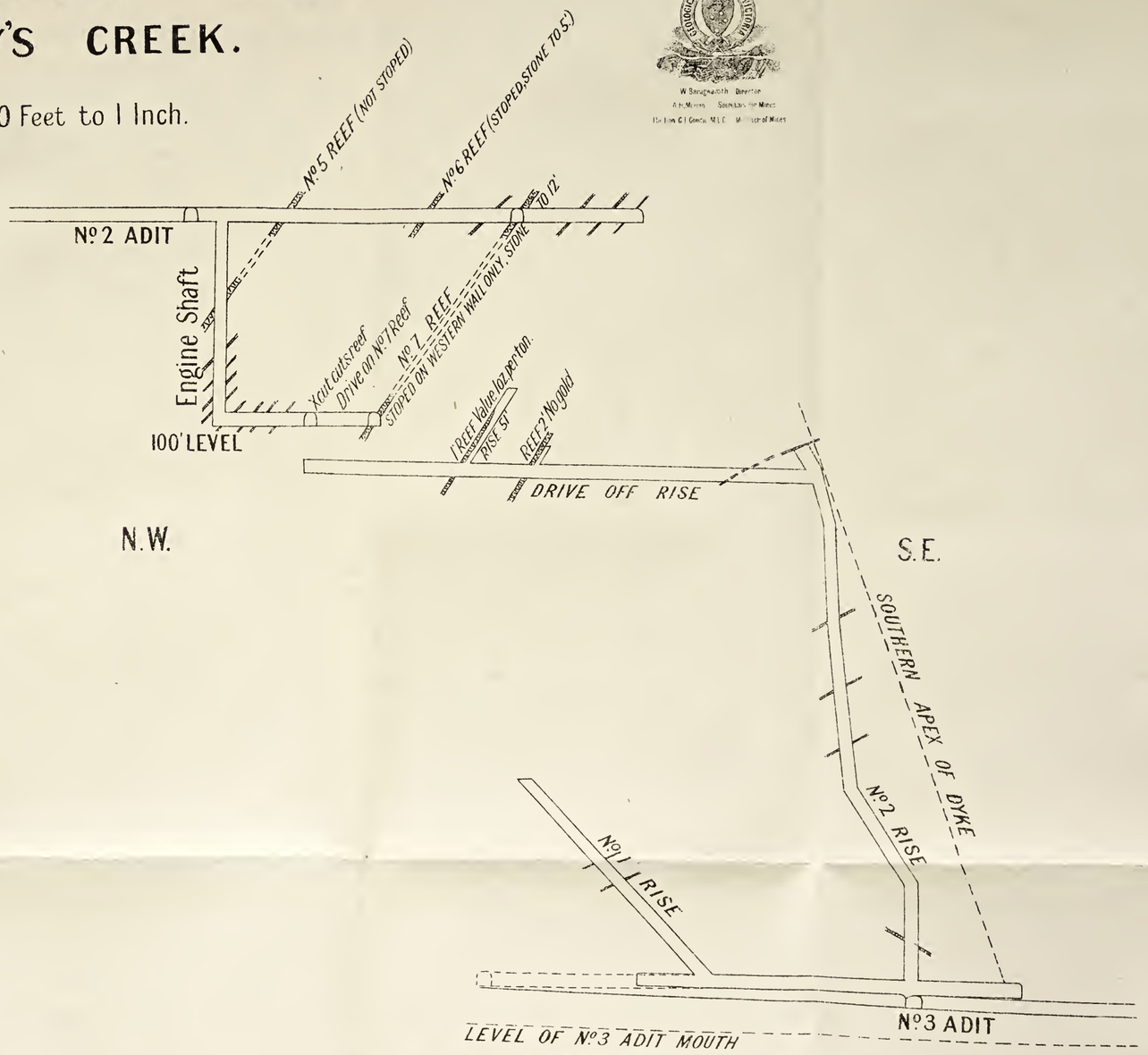
GREAT ELDORADO MINE

GAFFNEY'S CREEK.

Scale. 60 Feet to 1 Inch.


OUTCROP OF EASTERN WALL OF DYKE
No 2 ADIT
No 2 ADIT
OUTCROP OF WESTERN WALL OF DYKE
No 1 ADIT
EASTERN WALL AT No 2 ADIT LEVEL
Engine Shaft
WESTERN 100' LEVEL
No 2 REEF
WESTERN WALL DRIVE AT No 2 ADIT LEVEL
WESTERN WALL RISE
RISE
EASTERN WALL AT No 2 ADIT LEVEL
WEST WALL OF DYKE
No 1 RISE
100 FT LEV.
No 2 RISE
No 3 ADIT
Plug
Plug
WESTERN WALL AT No 3 ADIT LEVEL
Plane of Longitudinal Section
M. M.
Dyke capped by slate in level.
Slope 15' yielding 12 oz from 50 tons

PLAN



LONGITUDINAL SECTION.

3. The third scheme would require an extension of the south rise for 90 feet, and a drive north of 120 feet to connect with the No. 2 adit level. The work would not drain the old workings, and the rise is not well situated for economical development of a payable floor if such were located.

It is stated by old miners in the district that the cross-cut to the No. 7 reef from the engine shaft was continued towards the southern slates, but in the absence of any plan showing its position, to connect with it would be a difficult matter. The south rise is practically dry throughout its length, but, as it goes up under the capping slates and the floors dip away from it, this fact cannot be taken as an indication that the old workings will be dry. To obviate any risk the No. 2 tunnel should be cleaned out and the water baled from the engine shaft before a connexion is made.

The floor in the rise at 299 feet carries well mineralized stone in soft dyke country rock, and it is not unlikely that a floor carrying payable gold will be intersected in the unprospected portion of the mine if a drive is extended north from the south rise as suggested.

[16.2.22.]

ROSE OF DENMARK MINE, GAFFNEY'S CREEK.

By O. A. L. Whitelaw.

Operations of late years have been carried out from an engine shaft sunk from a chamber in the adit level. This is 600 feet in depth with levels at each 100 feet. The lode channel is primarily a dyke of the dioritic type varying in width from 3 feet to 8 feet, but at the shaft site it enlarges into a bulge or basin up to 40 feet wide and 150 feet long. About a dozen shoots of gold occur, all pitching north at an average of about 45°. Where these shoots of gold occur the dyke has been almost leached from the lode channel and replaced by secondary quartz carrying variable gold values. The records, which probably do exclude much gold won by co-operative parties, show that 42,731 tons of stone yielded 20,316 oz. of gold, and that £11,825 was paid in dividends. All the shoots of gold are south of the dyke-bulge and pitch towards it, but have not been worked to any extent therein.

The two main gold shoots, Gallagher's and Hogarth's, have been worked from the surface to the 400-ft. shaft level, and to a lesser extent to the 500-ft. level.

At 540 feet in the shaft a flat fault threw the dyke a few feet east, and although gold was found at the 600-ft. level under the fault, very little prospecting has been done. The last work carried out in the mine under the management of Mr. E. Hogarth was to extend the 500-ft. shaft level southwards along the dyke channel. This has reached 625 feet, the last 30 feet being in stone showing colours of gold. This gold shoot has not been touched between the adit level and the 500-ft. shaft level, and should the values be maintained between the two places, should yield about 620 feet of backs along the pitch.

Excluding for the time being the question of deepening the shaft, the policy for developing this mine at the 500-ft. level appears to me to be as follows:—

(*a*) Rise on the gold shoot cut at 625 feet, observing an angle of about 45° and putting out short north and south levels should the track of the gold be lost. Should the gold shoot maintain its values it will probably be necessary to extend some of the higher shaft levels to ensure air supply.

(*b*) Extend the 500-ft. level an additional 150 feet south to prospect for a shoot of gold said to have been worked under Cannon's Creek.

(*c*) Drive north at the 500-ft. level and thoroughly explore the dyke-bulge by cross-cuts to both walls, and if indications justify it, a rise be put up to No. 4 level.

[21.1.21.]

VICTORIAN A1 MINE, GAFFNEY'S CREEK.

By O. A. L. Whitelaw.

This report deals with the lower workings of the Victorian A1 Gold Mining Company at Gaffney's Creek. Attached is a plan showing the upper and lower mine workings, together with a transverse section constructed at a point 230 feet north-west of the engine shaft. The dyke area examined lies between the 982-ft. level and the 1,352-ft. level.

As more fully explained in memoir No. 3 (the Wood's Point Goldfield), the A1. dyke consists of a pipe or basin of intermixed dyke (diorite) and altered sedimentary rock (hornfels), enclosed in fairly normal Silurian sedimentary rocks. This basin has a length of about 500 feet by 150 feet, the richer gold occurrences however, being confined to a length of about 300 feet. The point of richest concentration appears to have been at an average distance of about 200 feet north-west of the engine shaft.

The method of reef formation is illustrated in the accompanying cross-section. The quartz veins have evidently been formed by the infiltration of siliceous matter into fissures resulting from the shrinkage of the dyke magma during consolidation. Proximity to the surface appears to have no influence upon the lode bodies, as the reefs at the lowest levels worked are quite equal in dimensions to those of the upper levels; and the enclosing dyke and hornfels show little alteration to the eye.

It is difficult to assess the true widths of the reefs, which at places may not exceed 1 foot or 2 feet, while at others they may, with reticulating veins, reach 10 feet or 15 feet. These veins are often richly auriferous.

Practically all the reefs have in some part proved auriferous from the surface to the No. 5, or 1,132-ft. level. Records prior to the present company's operations show a return of 63,987 oz. of gold; and since, to July, 1920, 56,005 oz., valued at £236,605 18s. 10d. Stoping is in progress on No. 5 floor and is proceeding both north and south on a large body of quartz. The southern stopes are probably at the farthest point yet worked south in the mine, and are within 100 feet of the engine shaft. The reef now appears to be breaking back into the normal slates.

In the stopes over No. 5 level what appears to be a large fault striking N. 48° W. and dipping 50° east is exposed just north of the main rise from No. 5 level, and minor faulting in the stope rise above No. 5 south level, striking N. 65° W. and dipping 47° N.; and in No. 5 level on the western slates striking N. 25° E. and dipping 39° W., may also be observed. The first-mentioned fault should be closely observed as it may have considerable influence on the gold deposition.

The No. 6 (1,252 feet) and No. 7 (1,352 feet) levels are still in the prospecting stage, and the reefs cut in the rises will have to be driven upon to ascertain their value.

In the cross-cuts in No. 6 an increase in the width or dyke material at the expense of the hornfels is observable.

In addition to the driving now being done on the reefs below No. 5 level, I would suggest that a rise be put up near the western slates to prospect the ground lying between Nos. 7 and 5 levels. It will be observed, by reference to the accompanying transverse section, that a large block of dyke exists between the known floors, and as similar sections in the upper levels were productive of auriferous floors, it is reasonable to anticipate that they may do so in the lower levels.

[16.8.20.]

Since my previous report increased attention has been given to the prospecting of reefs cut in the workings between the 1,132 feet and 1,352 feet levels.

No. 1 west cross-cut off No. 5 shaft level cut 2 feet of quartz dipping east. Nice gold is showing as the stone dips underfoot, and should it develop satisfactorily a new lease of life will be given the mine.

In No. 6 (1,252 feet) level the rise from the eastern cross-cut is being carried up and the two reefs which were intersected are being prospected.

In No. 7 (1,352 feet) western cross-cut, 6 inches of stone dipping 45° east was cut at 11 feet from the shaft drive, but has not been prospected. At 70 feet a well-defined floor about 2 feet thick was cut. This dips east at 45° and is having levels extended along it both north and south. A little gold is being obtained as the work proceeds.

The work at present being carried out is sound prospecting, and any satisfactory development at these lower levels will materially supplement the ore reserves now being worked at and above No. 5 level.

In addition to prospecting work outlined in my last report, I would suggest that No. 7 western cross-cut be extended further west, as it is quite possible the western wall of the dyke is still a considerable distance ahead.

[24.1.21.]

MORNING STAR MINE, WOOD'S POINT.

By O. A. L. Whitelaw.

The reef being worked at the 600-ft. level of the Morning Star mine is that cut on the western wall of the dyke-bulge about 18 feet east of the shaft. This was a body of mineralized quartz to 6 feet or 7 feet in thickness, and equal in appearance and size to any of the reefs worked in the upper levels of the mine. Colours of gold only were obtained upon the western side, but as the reef was driven on north along the

western wall, the usual northerly pitch was developed which carried the level on the reef to the eastern wall of the dyke. As this was approached the gold values gradually improved and gold showed freely as the eastern slates were reached. At the same time a rise was put up from No. 6 cross-cut near the eastern slates and the same reef cut about 40 feet below No. 5 level. The reef was about 5 feet in thickness and showed gold freely. These two points are over 200 feet apart, so a fair amount of ore is available. Stoping is in progress between the two points, the month's crushing prior to Christmas yielding 601 oz. of gold from 600 tons, exclusive of concentrates. In the north-east level the reef is pitching underfoot and carrying payable values. The company is about to sink the shaft a further 100 feet, and, in addition to driving out for the gold pitching underfoot, anticipates cutting an east-dipping reef under the No. 6 reef, and that it will prove payable on the western wall of the dyke. The mine appears to be in a very satisfactory position.

[21.1.21.]

NEW LOCH FYNE, MATLOCK.

By O. A. L. Whitelaw.

In Memoir 13, the Wood's Point District (1916), I remarked with regard to this mine, "As will be seen from the sections, auriferous reefs have been continuously worked from the surface to the bottom level, a vertical distance of over 500 feet. There can be no reasonable doubt that the system of auriferous reefs continues below No. 5 level, and that the sinking of the shaft below No. 5 level will place the mine on the list of regular gold producers."

Since this report, a new company has been formed, and a 16 by 4 feet shaft sunk 100 feet below No. 5, or main adit, level.

At 100 feet a level was put out in a north-westerly direction and close to the eastern wall of the dyke. At 160 feet a quartz floor was cut and driven upon north-westerly, and a cross-cut also put out west for 50 feet. The latter cut two floors of quartz, the first dipping easterly at 37°, and the second at 46°; these have not yet been prospected. A level has been continued on the first reef for 100 feet, and at 50 feet a rising stope 16 feet in length was put up on the reef. This has recently been connected with a western cross-cut from No. 5 adit level. The reef throughout the rise averages about 2 feet in thickness, and dips easterly, the lower section at 36° and the upper at 23°. 1,390 tons of stone from the rise-stope yielded 657 ozs. of gold. The length of the gold-shoot has not yet been ascertained, but fair grade stone exists from the 100-ft. level to the top of the stope 23 feet below No. 5 adit level. The laminated portion on the footwall of the reef contains very rich gold in places. The richness of the reef seems to be influenced by parallel "cross-heads," or fissures, striking due north and south and dipping west, which junction with the quartz floor. The developments in this mine are very satisfactory as far as they have proceeded, but much prospecting still remains to be done at and above the 100-ft. shaft level.

The cross-cut now out 50 feet at the 100-ft. level should be extended an additional 90 feet to 100 feet west to ascertain if any floors exist

under the one now being worked; and the main level should be continued an additional 200 feet north-west, and a cross-cut then put south-west to within 50 feet of the western wall.

The shaft is well situated as regards position, and should be sunk an additional 100 feet as soon as the company can see their way clear to do so. The most satisfactory policy of prospecting appears to me to be to drive north-west about 400 feet, keeping in the dyke about 20 feet from the wall. Cross-cuts should be put out towards the western wall at about opposite the shaft, and at 200 feet and 400 feet from the shaft. Levels should be connected by at least one rise put up in the dyke at about 25 feet or 30 feet from the eastern wall.

[27.10.19.]

The following notes deal with the underground work carried out at the New Loch Fyne mine, Matlock, subsequent to my report on the shaft workings in October, 1919.

The shortage of labour, combined with the severity of last winter, caused the abandonment of work below the adit level, and these portions of the workings were under water at the time of my recent visit. Since then work has been confined to prospecting just over No. 5 adit level, and about 200 feet of driving has been done in a south-westerly direction along the cross-heads or fissures in the dyke, which have a true north and south strike, and dip west at from 30° to 40°. These "heads" appear to have influenced the deposition of gold in some of the reefs, but as their dip is approximately similar to that of the quartz floors which dip from the eastern to the western wall of the dyke, they are more useful in prospecting the reefs which dip in the reverse direction. Nothing productive has yet been found in the work carried out, but the rise on No. 5 "cross-head" near the western wall of the dyke should be persevered with to cut any quartz floors connecting the west-dipping reefs worked by the old company where they turn over to connect with the floors cut in the main pass from the shaft to No. 5 adit, and with the reef recently worked by the present company below No. 5 adit level.

While much prospecting remains to be done between Nos. 4 and 5 levels, it appears to me to be subsidiary to the deepening of the main shaft, and the extension of cross-cuts therefrom under the reef worked from No. 1 shaft level, and from which 3,585 tons of ore yielded 3,296 oz. of gold. The gold in this reef is dipping underfoot below No. 1 level, and the return reef dipping from the eastern towards the western wall of the dyke should also be intersected.

The advisability of removing the compressors to a point lower down B.B. Creek, where an abundance of firewood is available, might also be considered.

[19.1.21.]

KNAPPING'S MINE, ABERFELDY.

By O. A. L. Whitelaw.

The mine workings are situated about three miles south-west of Mount Lookout, on the northerly extension of the lines of reef known as Anderson's. The lode channel has been cut by trenches and two

shafts, for a distance of 300 feet, down the face of a steep hill, and consists of about 2 feet of mixed sandstone and quartz leaders. There is little evidence of stoping, but Mr. Knapping showed me occasional fine colours of gold in the stone.

Fig. 109. Knapping's Mine, Aberfeldy. Scale : 100 feet to 1 inch.

Knapping's adit has been driven south on the western side of the reef, a distance of 569 feet, a cross-cut being put east at 155 feet, for a distance of 86 feet, and some subsidiary cross-cutting and driving done.

Some sandstone and quartz cut at 85 feet is considered the lode channel, but is too far in the eastern country to be so. At 35 feet in No. 1 cross-cut the reef outcrop is vertically overhead, and, as on the surface it has a slight western underlay, it should be cut between the main adit and 35 feet in the cross-cut.

No. 2 cross-cut is driven at 260 feet from the adit mouth, and has reached a distance east of 105 feet. At 17 feet in the cross-cut, the reef outcrop is vertically overhead. From the mouth of the adit to No.

1 cross-cut the beds are very broken; thence to 100 feet beyond No. 2 cross-cut a wall with a slight dip west has been followed; the wall then dips slightly east, and in the face of the drive apparently faults a formation of pug and quartz, formed on the reverse fault dipping flat west.

It is apparent from the survey that the formations cut in Nos. 1 and 2 cross-cuts are east of the reef outcropping on the surface; the vertical wall driven on is approximately in the position the reef should occupy at adit level, but as it shows very little formation and some movement, it is not unlikely it has faulted the reef. To ascertain this I would suggest that a rise be put up on the eastern side of the wall at the junction of the adit No. 1 cross-cut, say 40 feet; and a cross-cut then put out east about 25 feet.

[18.12.19.]

OVERSEAS OPTION MINE, WALHALLA.

By W. Baragwanath.

The Overseas Option mine is situated on the northern side of Black Diamond Hill, about 35 chains west of Stringer's Creek, Walhalla, and about 120 yards south of Consols Gully.

The workings consist of four shafts and a shallow tunnel, and lie 25 chains west of the outcrop of Cohen's line of reef.

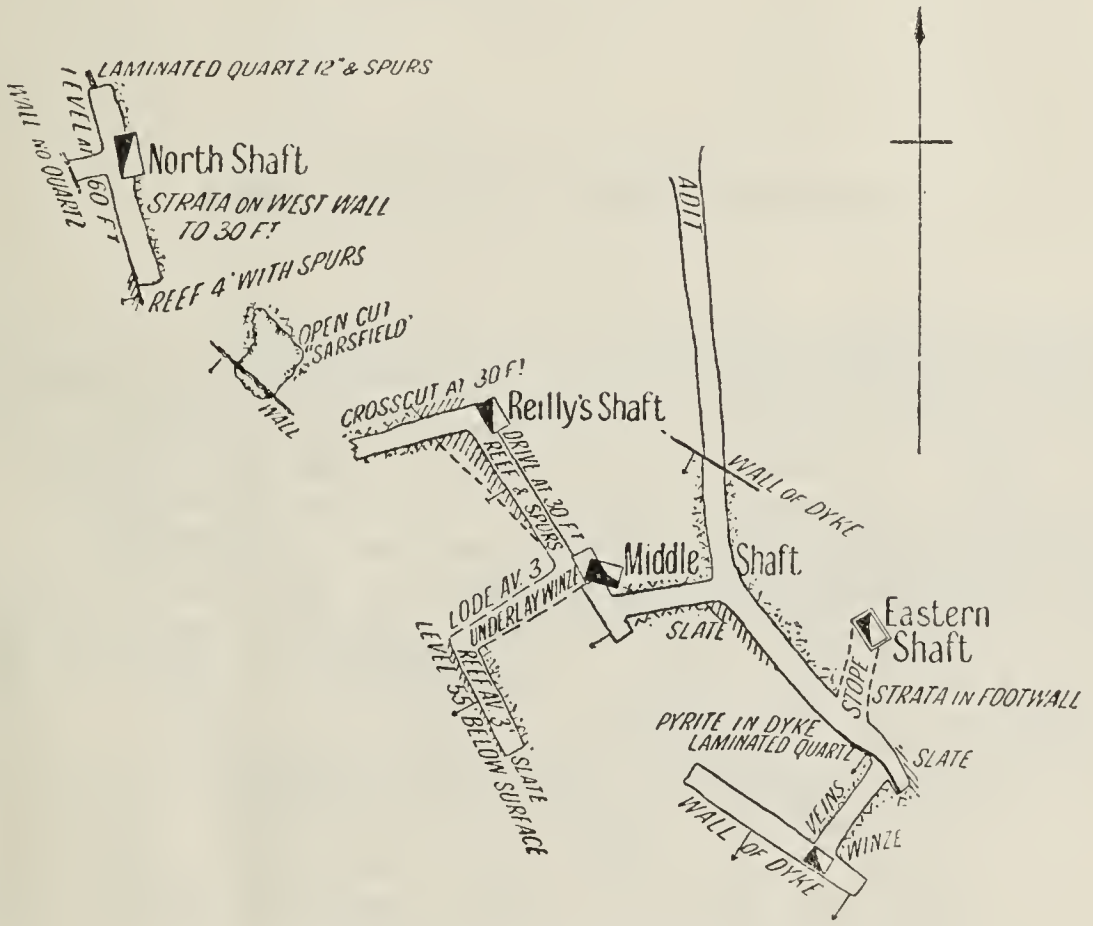


FIG. 110. Overseas Option Mine, Walhalla.
Scale: 60 feet to 1 inch.

So far as opened at present three distinct parallel lode formations are revealed, while a fourth channel formed on the southern wall of the dyke is proved at two points, one on the surface in the shallow cut of the Sarsfield workings, and again in the adit level.

The operations so far have been of a prospecting nature. The formations, which have a general strike of north 20° west to north 35° west, cut across a dyke upwards of 60 feet in width, which appears to have a general strike of north 60° west. The formations near the surface are typical of those proved elsewhere in the district in similar dykes, and are more or less spurry, associated with good walls, and at a depth in the three deepest shafts develop into solid bodies of laminated quartz with a westerly underlie.

Gold is present in all the formations as proved by several dish prospects, and the show generally warrants opening in a systematic manner, for which purpose I would suggest the driving of an adit from Consols Gully to command from 80 to 100 feet of backs, and to test more economically the value of the ore bodies already disclosed, and also to endeavour to locate other parallel formations.

In general character the formations are similar to those proved at the Eureka and the Longfellow's mines, where the dyke is cut through and faulted by the reef channels which die out in the adjoining strata, the gold contents being associated with the dyke, and is often richer where one wall of the reef consists of strata. Several cases of "wedging in" of strata along the lode channels are visible in the mine workings under review, as shown on accompanying plan.

The mine is well situated for economical working, and the presence of a State battery within half a mile of the workings allows of cheaply testing any ore bodies that may be opened by the suggested adit.

[16.2.22.]

CROWN MINE, MOUNT TARA.

By Stanley Hunter.

The attached plan and section of the Crown mine are from a compass survey, and, therefore, only approximate, and when the reef is cut in the 93 feet level a detailed geological survey of the mine should, I think, be made, together with a complete sampling of values from every part of the mine for gold, copper, silver, and lead. Should the latter work prove that gold values are satisfactory or even encouraging, and the reef be undiminished in thickness, the question of sinking a winding shaft, and shifting the hoppers, tram line, and battery to a site on the south or opposite side of the spur, should be fully considered for the reasons:—

1. The true underlay of the reef appears to be to the south-east, and any suggestion for a new tunnel to gain "backs" at a level below the present one, and on the north-west side of the spur, would be merely a temporary expedient and not good mining.
2. The present site of battery is unwisely selected, for there is neither room for a dam of reasonable capacity, nor for tailings, and trouble will soon arise if the mine is extensively developed. The battery is only a few feet above the bed of the gully, in which no water runs for about seven months of the year.

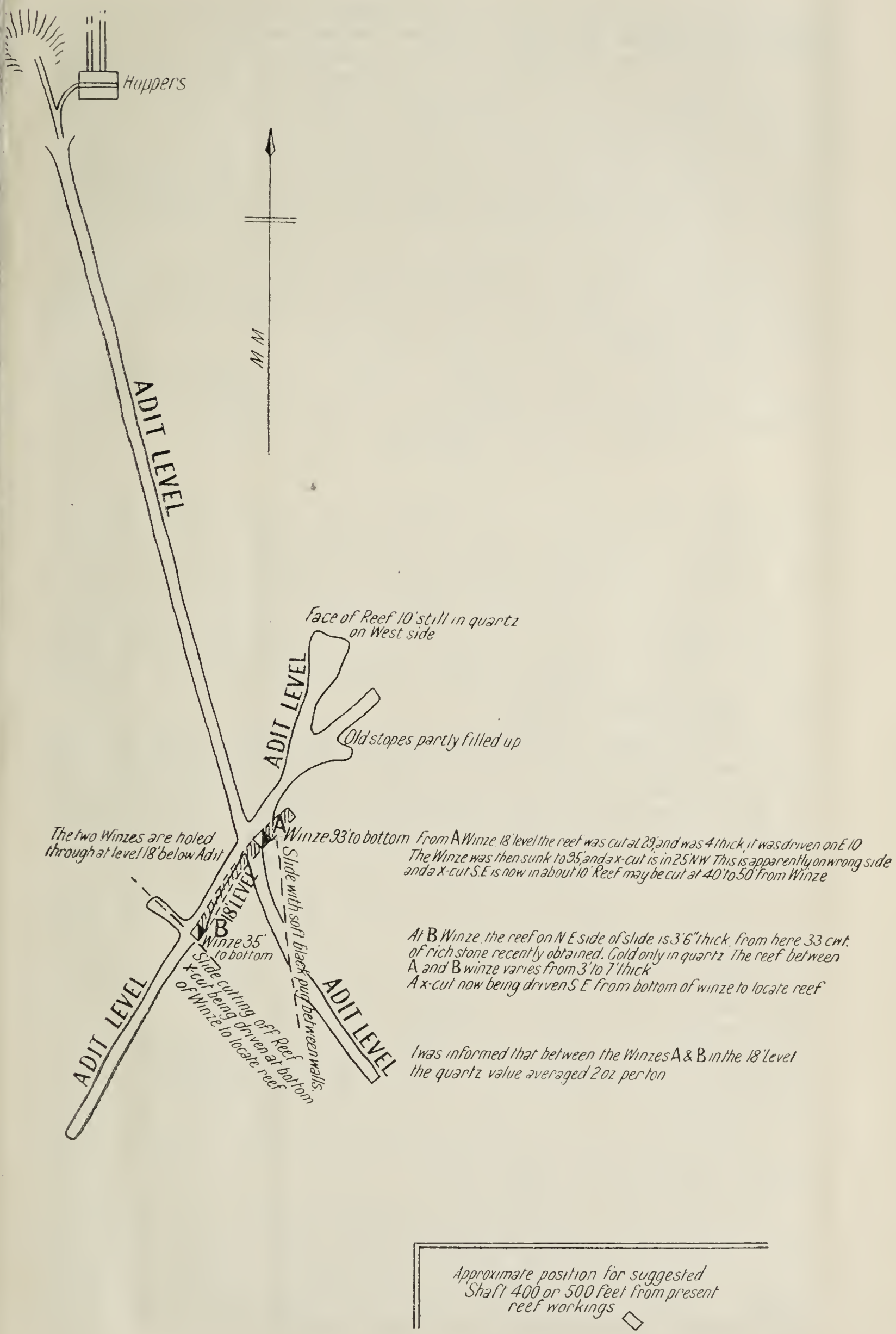

Hoppers
N W
ADIT LEVEL
Face of Reef 10' still in quartz on West side
ADIT LEVEL
Old stopes partly filled up
The two Winzes are holed through at level 18' below Adit
A
Winze 93' to bottom
From A Winze 18' level the reef was cut at 29', and was 4' thick, it was driven on E 10
The Winze was then sunk to 95', and a x-cut is in 25 N W This is apparently on wrong side and a X-cut S.E is now in about 10' Reef may be cut at 40' to 50' from Winze
Slide with soft black pug between walls
18' LEVEL
B
Winze 35' to bottom
At B Winze the reef on N E side of slide is 3' 6" thick, from here 33 cwt. of rich stone recently obtained. Gold only in quartz The reef between A and B winze varies from 3' to 7' thick
A x-cut now being driven S E from bottom of winze to locate reef
ADIT LEVEL
Slide cutting off Reef, x-cut being driven at bottom of Winze to locate reef
ADIT LEVEL
I was informed that between the Winzes A & B in the 18' Level the quartz value averaged 2 oz per ton
Approximate position for suggested Shaft 400 or 500 feet from present reef workings

Fig. 111. Mount Tara Crown Prospecting Syndicate Mine, Mount Tara.

On the walls of the drives are considerable areas covered with fine hexagonal needles of copper sulphate, corresponding in appearance and colour to Dana's description of Connellite. Galena also occurs in small lenses and veins, but I am not hopeful that any development in these minerals can be anticipated; at the same time they form an appreciable percentage of the concentrates being saved on the table.

Mr. Reedy, the shift boss who showed me over the mine, stated that the whole of the quartz exposed in the 18 feet level between the two winzes would yield probably from 1 to 2 oz. gold values; if this is so the mine should certainly prove to be payable.

The plant consists of a ten-head battery with tables, pump, &c., double cylinder portable steam engine, shaking table, about 8 chains of self-acting tram road and wooden hoppers at mouth of tunnel. The whole plant appears to be in fairly good order.

The future of the mine largely depends upon what is proved in the 93 feet level. If the thickness of reef and values are sustained, it should have a life of several years on a payable basis.

[14.7.19.]

KONG MENG MINE, DARGO.

By J. P. L. Kenny, B.C.E.

The Kong Meng Mine is situated on the Black Snake Creek, about 3 miles from its junction with the Wonnangatta River, and 8 miles from the township of Dargo. The following particulars are compiled from departmental records:—

The Kong Meng Company was formed in 1867 to work the reef known as the Black Snake, from which a trial crushing of 7 tons had averaged 25 dwt. of gold per ton. The company worked the mine for about three years, and the crushings, as recorded in the Quarterly Reports of the Mining Registrars, were as follows:—

Date.	Ore Crushed.	Gold per Ton.	Total Gold.	Depth, &c.
	tons.	oz. dwt.	oz. dwt.	
March, 1866 ..	7	1 5	8 15	55 feet
March, 1868 ..	60	1 4	71 4	30–50 feet
March, 1868 ..	20	0 18	17 18	40 feet
September, 1868 ..	30	0 11	16 0	
September, 1868 ..	20	0 12	12 0	Nos. 1 and 2 South
December, 1868 ..	62	1 2	68 14	60–100 feet
March, 1869 ..	56	1 3	65 0	60–100 feet
December, 1869 ..	12	0 5	3 0	40 feet

Giving a total of 267 tons crushed for a yield of 262 oz. 11 dwt., an average of 19.7 dwt. per ton.

After the company ceased work the mine lay idle for a number of years, until it was taken up by a syndicate, and a lower tunnel was driven along the line for about 150 feet, when work was stopped without reaching the objective. In 1907 Messrs. J. Bamford and W. Francis obtained a government grant to extend this tunnel. In a report made by Inspector Hawke in that year it is stated that the reef was worked on the surface for a length of 600 feet, and to a depth of about 120 feet. He considered that it would be necessary to extend

the tunnel a distance of 150 or 200 feet to cut the continuation of the shoots worked in the levels above. The party extended the tunnel for a distance of about 150 feet on a small laminated quartz reef with a little fine gold in places, but nothing payable.

In a letter to the Mines Department in 1904, John Bamford stated that the record books of the Kong Meng Company showed that 600 tons crushed gave an average of over 1 oz. of gold per ton. The Mining Registrar's returns are incomplete,and this is probably correct. Since Bamford's party ceased work nothing further seems to have been done on the mine.

[23.12.21.]

UNION AND DORRITT MINE, GRANT.

By J. P. L. Kenny, B.C.E.

The Union and Dorritt Company held a lease about half a mile north of the former township of Grant. Included in the area are four auriferous reefs known as the Union, the Little Dorritt, the Italian, and the Vulcan. The country rock strikes W.20°N. and consists of slightly metamorphosed Ordovician sandstones, with an occasional bed of slate.

The Little Dorritt Reef.

The Little Dorritt line strikes W.13°N. and dips 72°S. It is a well-defined line and can be traced for a length of 20 chains. It was discovered in 1864, and a shoot 160 feet long was worked to a depth of 180 feet by means of shafts and an adit driven westerly along the line. At the point where this adit intersects the reef a decomposed dyke 12 inches wide cuts diagonally across the line. This adit follows the reef which is 6 inches to 18 inches wide for 480 feet, at which point the old stopes begin and the drive has collapsed. The reef is stoped from the surface to this level (a depth of 135 feet) and two winzes about 40 feet deep are said to have been sunk below the level. To test this reef at a greater depth the Union and Dorritt Company extended an adit originally driven to the Vulcan reef. At 940 feet in this adit a dyke was cut carrying quartz veins and a drive was extended 520 feet on this formation, which strikes W.37°N. and dips 60°S.W. The dyke is 1 ft. to 2 ft. wide and carries up to 18 inches of quartz, chiefly on the footwall. Nothing payable was found in the drive on this formation, which was originally taken for the Little Dorritt line, and at 225 feet in the drive a cross-cut was put out south and cut what is without doubt the Little Dorrit line at 120 feet. A drive has been extended westerly on the line for 400 feet and at 70 feet from the cross-cut a rise was put up 35 feet but nothing payable was located. The reef dips south from 68° to 87° and carries from 3 inches to 12 inches of quartz. At 350 feet in the drive a diagonal reef from the south junctioned with the Dorritt line, and at this point the most promising indications seen in the level were found—the diagonal reef carried 3 feet of quartz in oxidised

country with a little gold. A short cross-cut was driven from the Dorritt line to the diagonal reef and the drive continued south-easterly on it to a point 80 feet from the junction. In the west face of the main drive the reef is 4 in. wide and dips 78°S. The stopes on the Little Dorritt line above the upper adit level indicate that the shoot is vertical and the lower adit has tested the reef where the continuation of the shoot might be expected at that level. To prospect further the Little Dorritt reef, a rise could be put from the lower level at the point where the diagonal reef unites with the Little Dorritt line, or a winze might be sunk from the present end of the upper adit level to a depth of about 100 feet and a drive extended west on the line from the winze.

The following yields from the Little Dorritt reef are recorded in the Quarterly returns of the Mining Registrars:—

Date.	Ore Crushed.	Gold per Ton.	Total Gold Yield.	Depth.	Remarks.
	tons.	oz. dwt.	oz. dwt.	feet.	
September, 1865 ..	28	0 12	16 10	30	
March, 1867 ..	26	0 18	23 0	80	Steers and Company
June, 1867 ..	9	0 19	8 10	90	Steers and Company
March, 1868 ..	70	0 11	40 0	90	Steers and Company
September, 1868 ..	30	0 10	15 0	..	Steers and Kane
March, 1869 ..	13	1 11	20 0	150	Steers and Kane
September, 1869 ..	24	0 15	18 0	150	
June, 1875 ..	8	0 3	1 4	60	Gladstone and Company
December, 1882 ..	28	1 2	30 18	0–30	Treasure Hill Q.M. Co.
Total ..	236	0 14·7	173 2	..	

The reef was worked for 6 months prior to September, 1865, but the crushings are not recorded.

The Italian Reef.

The Italian reef which outcrops on the south side of the Little Dorritt line, has well-defined walls with 6 inches to 12 inches of quartz. It strikes E. 35° N. and dips 86° S.E. It has been stoped for a length of 80 feet, the stopes beginning at a point 25 feet from the Dorritt line. On the south end of the stopes there is a shaft recently cleaned out 95 feet deep. From the bottom of this shaft which is below the old stopes, a drive was put out 20 feet north-easterly on the line without striking payable stone. The reef has not been definitely located in the Upper Dorritt adit level. A drive was put out for 60 feet from the Little Dorritt reef in a direction parallel to the Italian reef. No wall shows in this drive and I do not think it is on the Italian line. Fifteen feet west of this drive an inch quartz vein shows in the hanging wall of the main drive; this may be the Italian line, but it does not correspond in strike. If a cross-cut were driven westerly from the end of the 60 feet drive it should cut the Italian reef at about 12 feet. This level is 50 feet below the bottom of the 95 feet shaft on the Italian reef.

Plate No. LVII.

RITT

feet to l i

THE UNION & DORRITT MINE, GRANT.

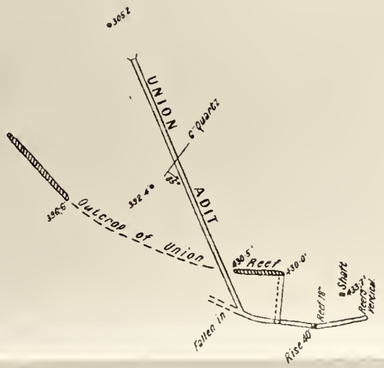
Scale, 132 feet to 1 inch

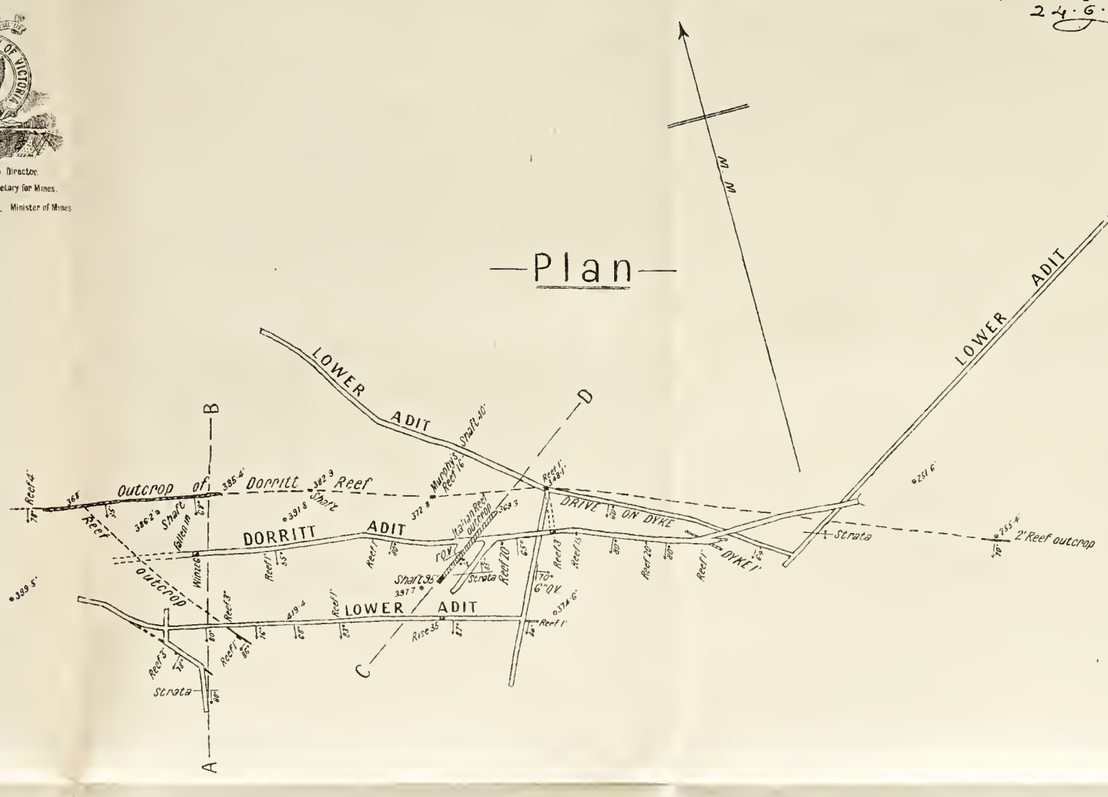
Heights above low adit level shown thus - 385·4'

GEOLOGICAL SURVEY OF VICTORIA
W. Baragwanath, Director.
A.H. Merrin, Secretary for Mines.
The Hon. G.L. Goudie, M.L.C., Minister of Mines.

24·6·21

Plan





In the lower adit level a 6 inch quartz vein dipping 70°E. was followed in the cross-cut from the dyke to the Little Dorritt reef; this may be the Italian line at that level, but it does not agree with it in strike.

Only one crushing is recorded from the Italian reef—in December, 1856, when 62 tons yielded 156 oz. 5 dwt., an average of 2 oz. 10 dwt. per ton.

The Union Reef.

The Union reef outcrops 200 feet south-west of the western end of the Little Dorritt line. It strikes W.18°N. and is from 1 foot to 2 feet wide with a dip of 70°S. To the west the reef turns in a northerly direction and strikes N.24°W. Two shoots have been worked on the line. The eastern shoot is 45 feet long and has been stoped to an adit level a depth of 125 feet. This adit cuts the line in a cross-cut 240 feet long and there is a drive east of 110 feet. A drive, now collapsed, was also extended westerly and the reef is said to have been stoped over this drive. No work has been done on the reef below this level. A second shoot about 80 feet in length has been worked on this line 155 feet further north. An adit was driven from the north on the line of reef towards these workings but nothing payable appears to have been located. The Little Dorritt and Union reefs may possibly be the same line displaced by a fault, though beyond the fact that the reefs appear to die out at two points approximately opposite each other, there is no evidence of this. To extend the lower adit to the Union reef would require an angle drive from the west face in a south-westerly direction of about 320 feet. Unless payable stone were first proved below the adit level the prospects would not warrant the outlay.

The following yields are recorded from the Union reef:—

Date.	Ore Crushed.	Gold per Ton.	Total Gold Yield.	Depth.	Remarks.
	tons.	oz. dwt.	oz. dwt.	feet.	
March, 1865 ..	200	2 14	540 0	90	Upper shaft
March, 1865 ..	69	1 0	69 0	70	Lower shaft
September, 1865 ..	90	2 4	198 12	80	
December, 1865 ..	277	1 2	310 0	110	
March, 1866 ..	70	1 6	92 0	130	
June, 1866 ..	200	0 11	110 0	130	
December, 1877 ..	12	2 19	35 16	250	Sons of Freedom Co.
March, 1878 ..	110	1 10	165 0	0–60	
Total ..	1,028	1 9·6	1,520 8	..	

The Vulcan Reef.

The Vulcan reef crosses the lower adit at a point 445 feet from the adit mouth. A number of shafts were sunk along the line and at the adit level drives were put out 160 feet north-westerly and 100 feet south-easterly on the reef. The reef is said to have been stoped to a depth of 40 feet below this level. The drives are not now accessible. The reef followed a dyke line and carried from 6 in. to 12 inches of quartz; the payable stone occurred in a succession of short shoots.

The following crushings are recorded from the Vulcan reef:—

Date.	Ore Crushed.	Gold per Ton.	Total Gold Yield.	Depth.	Remarks.
	tons.	oz. dwt.	oz. dwt.	feet.	
June, 1867 ..	11	4 0	44 0	60	Sayers and Manuel
September, 1867 ..	21	2 0	42 7	80	Sayers and Manuel
December, 1867 ..	20	4 7	87 3	110	Sayers and Manuel
June, 1868 ..	35	4 16	168 14	40	Sayers and Manuel
September, 1868 ..	67	1 1	72 0	..	Sayers and Manuel
March, 1869 ..	40	1 4	47 18	70	Sayers and Manuel
March, 1871 ..	18	0 6	5 5	80	Manuel and Company
December, 1874 ..	9	0 11	5 0	50	Gladstone and Company
September, 1872 ..	20	0 1	1 10	100	Treasure Hill Co.
December, 1882 ..	28	1 2	30 18	0–30	Treasure Hill Co.
Total ..	269	1 17·5	504 15	..	

[21.6.21.]

MOUNT ALWA TIN MINE AND SPICER'S CLAIM, WALWA.

By John G. Easton.

The Mount Alwa mine is situated about 1½ miles west of the township of Walwa, close to the main Walwa to Wodonga road, in Allot. 5, Sec. II, Parish of Walwa, on a low terminal spur, as indicated on the accompanying locality plan.

Highly metamorphosed Ordivician strata consisting of nodular and micaceous schists are the prevailing rocks of this locality. Into these have been intruded a series of granitic rocks, varying from coarsely crystalline to fine-grained granite, pegmatite and greisen, carrying more or less cassiterite. Some of these have produced very rich specimens and patches of tin.

About six or seven years ago the Walwa Tin Mining Company erected a battery on the bank of the Murray River, constructed a tramway about half-a-mile in length from the main workings, and treated some thousands of tons of low-grade material for results shown hereunder:—

——	Ore Raised.	Cassiterite Won.		Value.
	tons.	tons cwt.	per cent.	£
1913—				
Lease 2915 ..	2,655	6 9	0·24	735
Lease 2876 ..	934	2 6	0·25	260
1912—				
Lease 2876 ..	2,650	8 15	0·33	1,110

These returns give more reliable data upon which to judge the value of the material in bulk than any number of assays of samples. Taking the above returns, the ore contains 0.28 per cent of cassiterite on the average.

This company's workings may all be defined as surface prospecting, as the greatest depth worked in any of their quarries or open cuts does not exceed 15 feet.

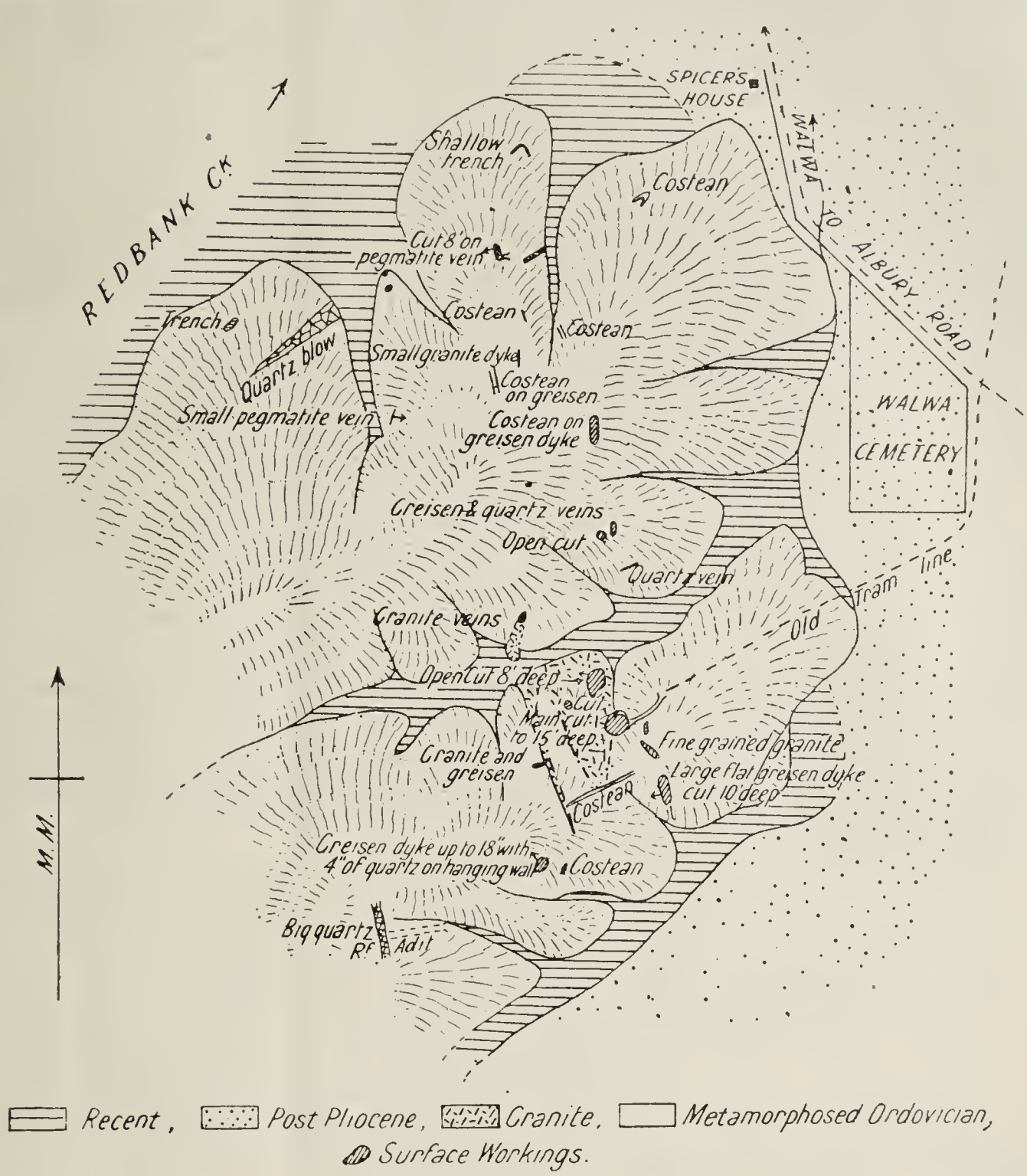


Fig. 112. Locality plan of Walwa Tin Mine and Vicinity.
Scale: 15 chains to 1 inch.

The most extensive operations were confined to two large quarries which were connected with the battery by means of a tram, as shown on plan. These quarries are on the edge of a large granite formation which exhibits a coarsely-banded structure suggestive of its being the surface of a boss, the banded structure being due to differentiation in the cooling of the magma, or it may be a large flat dyke or sill from the adjacent granite, as is suggested by the section in the more northerly of the two cuts, which shows a large flat formation apparently dipping to the west and occurring in bands of pegmatitic felsitic granite, with metamorphic rocks overlying. Tin oxide is visible in isolated blebs chiefly in the pegmatite.

Three other quarries, varying up to about 10 feet in depth, have been opened within 5 chains south of the main cut, on fine-grained granite and greisen formations in which tin oxide is to be seen; one of these

quarries is 66 feet long by 18 feet wide. For half a mile to the north to the Murray flats, a number of small greisen and granitic spurs and veins have been opened up by small surface cuts and costeans, some of which have produced very fine specimens of stanniferous greisen, but none of them appear to have warranted following to any considerable depth.

Spicer's Claim.

About 50 chains S.W. of the Alwa Company's workings, in and near the north boundary of allot. 5^b, sec. II., Mr. Spicer has opened up an E. and W. dyke several chains in length and averaging about 2 feet in width and dipping 20°S. in vertical nodular schistose strata. The ore appears to be patchy in this lode, being found chiefly on the hanging wall of the load in a fine greisen.

He has also opened up some very nice tin disseminated in fine crystals throughout a greisen matrix containing a pale yellowish mica on the eastern wall of a large granitic formation about 10 chains further north, but this appears to be very patchy.

Mr. Spicer has erected a small crushing plant of 3-head of stampers and a Wilfley table worked with an oil engine on the bank of the Murray River, and at the time of my visit had a fair amount of material stacked for treatment. He also had a kerosene tin full of fine specimens and crystals, which he obtained from a specimen from near this locality. I have recently heard that he has recovered about £600 worth of tin, and sold his claim and plant for £1,600 cash.

I consider this locality suitable for small co-operative parties such as the above, but am not favourably impressed with the opportunities for large companies.

[15.5.20.]

BOUNCE TIN MINING CO., WALWA.

By J. G. Easton.

During my recent inspection of the Mount Alwa Tin Mining Co.'s working at Walwa, I took the opportunity to look over the Bounce Tin Mining Co's. lease, which is contiguous to the above on the north.

This company, which was recently formed in Sydney, has its claim under the management of Mr. Terry, who previously managed the old Walwa Tin Mining Co's. mine in 1912-13.

Embraced in this lease are a considerable number of small stanniferous veins and spurs referred to in my previous report on this locality, also a large granitic outcrop to the west of these veins which was inadvertently overlooked in my survey of this area.

At the present time a small 3-head battery is crushing ore from a soft, decomposed, highly felspathic, fine-grained granitic formation which has been opened up under the shallow detrital surface material immediately to the north of the schist outcrop at the rear of Mr. Spicer's house. This formation has been opened up for a length of about 3 chains by open cuts and a drive to a maximum depth of about 15 feet and ranging up to a similar width. The whole of this ore is easily worked with pick and shovel, and Mr. Terry informs me that it is giving a 2% extraction.

The manager's chief energies are at present directed towards the erection of an up-to-date treatment plant, consisting of a 10-head battery with an equivalent number of Huntington mills, ore classifiers, jigs, concentrating tables, slime tables, etc. The foundations for this plant are just being prepared.

Mr. Terry's chief objective is the large granitic outcrop previously referred to, from which favourable prospects of tin can be obtained, and Mr. Terry bases his estimates on a 1% yield, but this is a question that can only be demonstrated by bulk treatment. There is no need for any misgivings as to the quantity of material available in this outcrop, which is several chains in width. Many of the other small surface outcrops may probably open out in larger bodies if developed.

From what I saw I feel sure that this company is going the right way about giving the locality a fair trial and proving its merits as a low-grade proposition.

[12.3.21.]

CASSITERITE AT BEENAK.

By W. Baragwanath.

I paid a visit on the 22nd inst. to Basans Corner, Parish of Beenak, 8 miles N.E. of Gembrook railway station, on the Bunyip-Yarra divide, to inspect a site where tin ore was found *in situ*. In a vein in the granite occasional specks of cassiterite were noticeable, but the deposit is not one that warrants further prospecting as the class of material is not likely to be continuous, the vein being only a fine-grained variation of the granite mass. As alluvial tin is common in the gullies in the vicinity, the occurrence of lode tin is of interest, but I am of opinion that the alluvial tin is a secondary concentration from the old leads which underlie the basalt cappings now found on various parts of the ranges. The country generally is unsuitable for prospecting for tin lodes as the heavy deposits of soil completely masks all except the large granite boulders.

[24.3.22.]

SOFT LODE TIN MINE, GLEN WILLS.

By J. P. L. Kenny, B.C.E.

The formation known as the Soft Lode is situated on the eastern side of Glen Wills Creek, at the north end of the township.

Glen Wills marks the southern end of a belt of tin-bearing country which extends north to Tallandoon, a distance of 35 miles. The country rock in this area consists of schists of many varieties and phyllites; intersecting these are pegmatite dykes, sometimes reaching 100 feet in width. The dykes carry tourmaline and cassiterite as accessory minerals, the former being usually absent when cassiterite is present. Other minerals commonly associated with tin ore (wolfram, floorspar, &c.) are also absent, so that the lodes only carry quartz, felspar, muscovite, and cassiterite. Griesen (quartz and muscovite) occurs in bunches in the pegmatite, and the richer tin ore is usually associated with it.

The lodes, as a rule, are nearly vertical, but the Soft Lode is an exception in this respect, being an almost horizontal vein dipping north-westerly at about 5°. In 1890 the Soft Lode, in conjunction with other lodes, was taken up by the South Mount Wills Company, and a treatment plant was erected at the lower end of the township. From the Soft Lode 500 tons of ore yielded 8 tons 5 cwt. of tin oxide, an average of 1.65 per cent. These concentrates on being smelted yielded 4½ tons of metallic tin, equivalent to 0.9 per cent. of metallic tin in the material treated. When the South Mount Wills Company ceased work, the mine lay idle until it was taken up by a local syndicate in 1913. Active operations were at once commenced, a battery and concentrating table were erected on the creek, a road was cut from the mine to the battery, and a new adit level was driven 40 feet below the lode outcroup. From this adit a connexion was made with an old adit driven by the South Mount Wills Company, and the lode has been stoped out up to the old workings. The lode is from 2 feet to 6 feet in thickness, and the richer ore was found to occur in two shoots pitching north-west, as shown on the accompanying plan. The syndicate crushed about 300 tons of ore, and obtained 6 tons of oxide. The tailings from the ore crushed by the syndicate were sampled by me and assayed at the Geological Survey laboratory. The result showed that the tailings contained less than 0.3 per cent. of metallic tin. Possibly losses of fine tin occurred in the slimes, but the amount has not been determined. In the lower adit level the lode was cut off by a diorite dyke running approximately east and west, while to the south-west the lode has been worked up to a fault, and has not been located beyond it. By cross-cutting north through the dyke at the lower adit level, the lode may be again located; beyond the fault the lode has been displaced either upwards or downwards. I am inclined to think that the movement has been downward, and a winze on the south-west side of the fault, or a prospecting shaft from the surface, may reveal it.

[18.3.18.]

IRON ORE AT NOWA NOWA.

By A. M. Howitt.

At Boggy Creek, Mt. Nowa Nowa, and the "Seven Mile," leases have been re-applied for, and certain of the iron ore bodies known to occur in the Nowa Nowa district are to be further prospected.

In this report an endeavour is made to give a general description of the character and value of the ore occurrences in the various lodes as observed in the surface outcrops and small working cuts. The deposits north of the "Seven Mile" are not included in this report.

Boggy Creek Area.

The Boggy Creek main lode occurs in a brown porphyry rock (Snowy River series), and is a siliceous banded ore body showing very little iron ore along the surface outcrops, but lenses of high-grade ore occur in places, especially where a change in the strike of lode is seen. Along this lode three new iron blows have been located by Mr. J. Dillon,

Records Vol. IV,

Plate No. LVIII.

T LODE TIN MINE

LEN WILLS

SCALE OF FEET

20 40 60 80

20 Feet, Thickness of lode shown thus 3'6"

4.4.18

60'

A---D

80'

Fallen in

100'

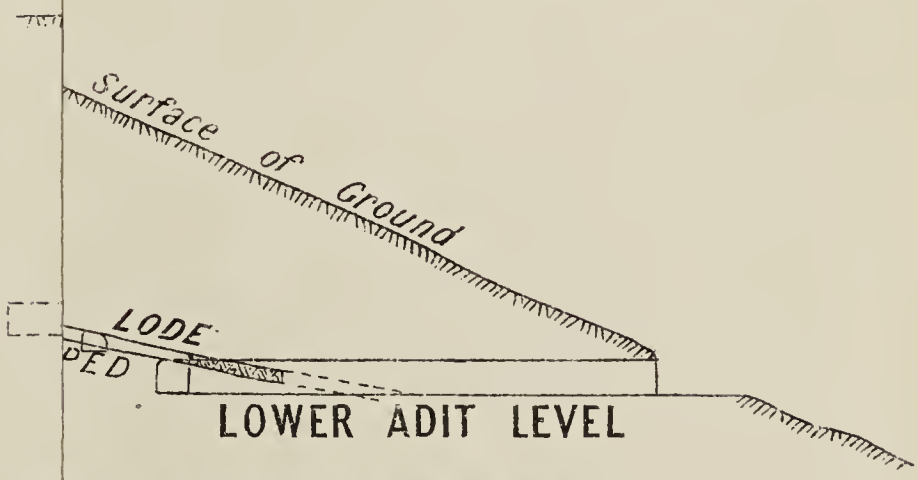
THE EARTH YIELDS HER SECRETS

GEOLOGICAL SURVEY OF VICTORIA

W Baragwanath, Director.

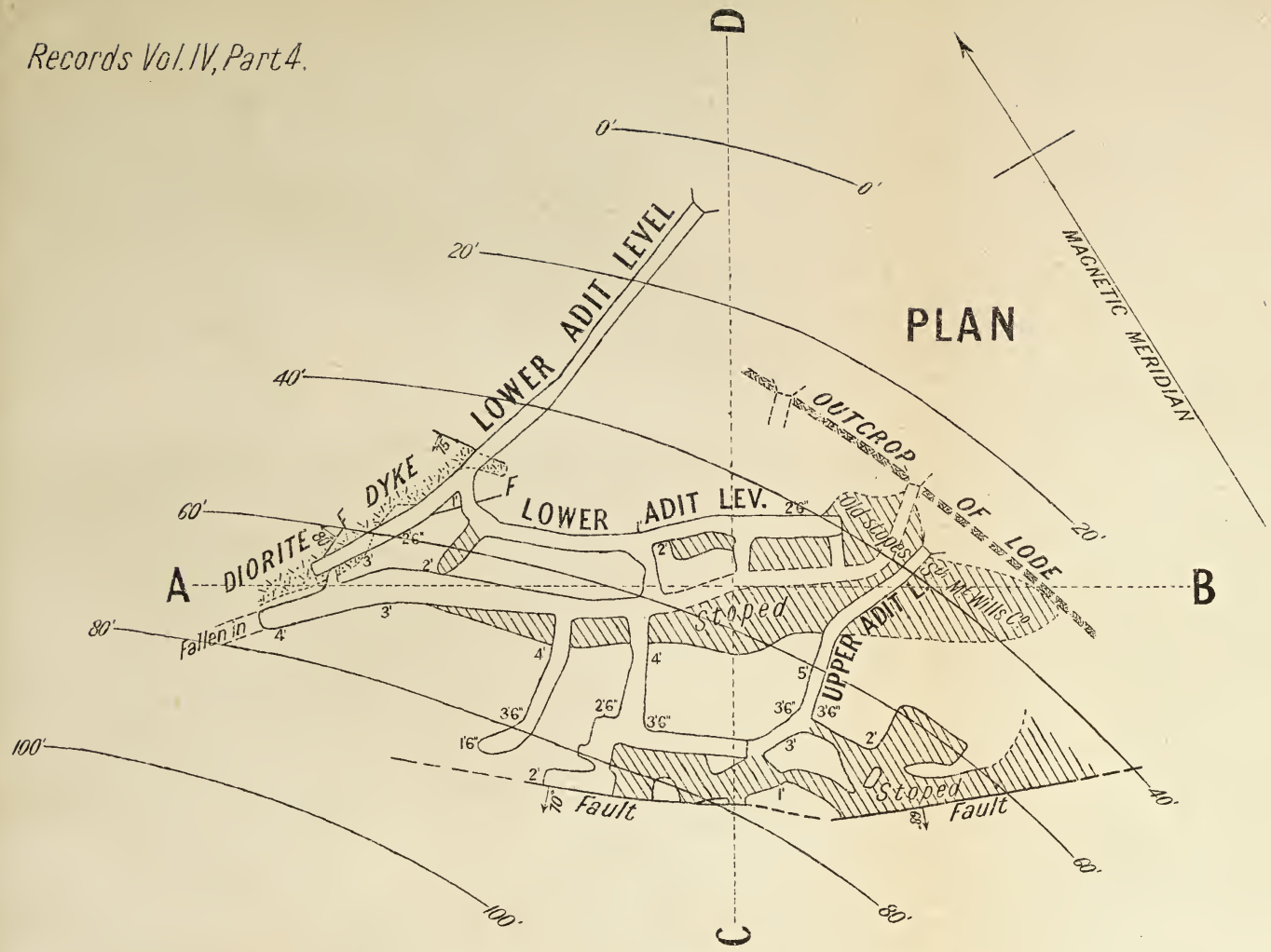
A.H.Merrin, Secretary for Mines.

The Hon. C.I.Goudie, M.L.C., Minister of Mines.



E SECTION C-D

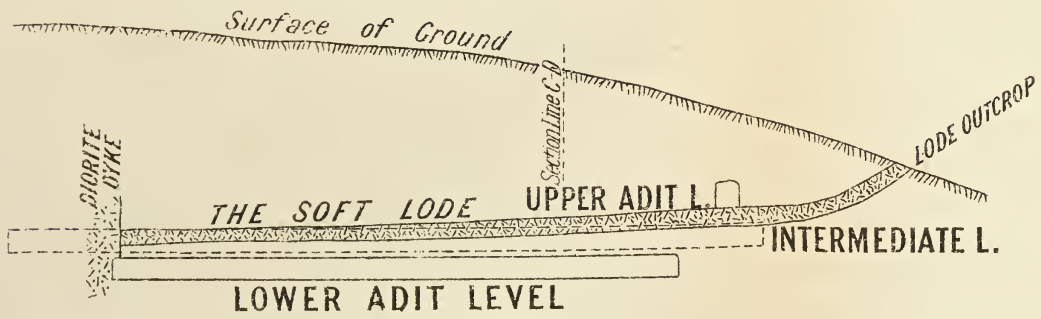
THE SOFT LODE TIN MINE
GLEN WILLS



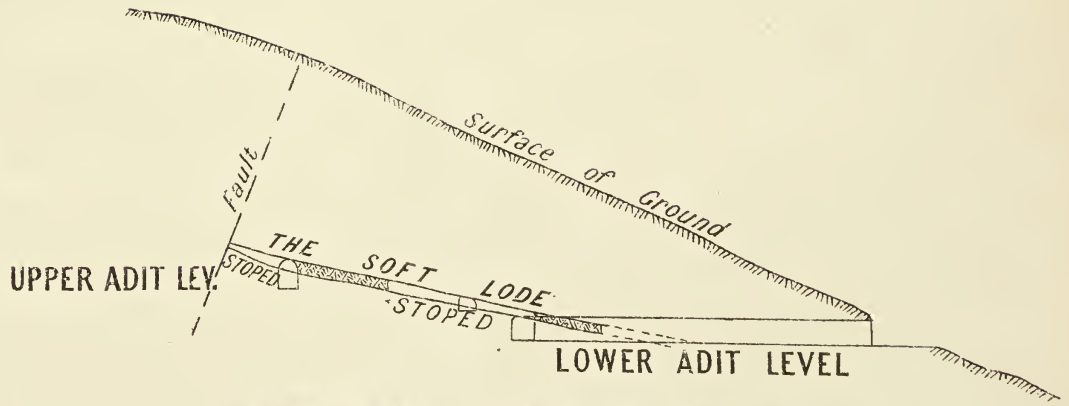
SCALE OF FEET
0 20 40 60 80

Contour Interval-20 Feet, Thickness of lode shown thus 3'6"

W Baragwanath, Director.
A H Merrin, Secretary for Mines.
The Hon. C.I. Goudie, M.L.C., Minister of Mines.



LONGITUDINAL SECTION A-B



TRANSVERSE SECTION C-D

who is in charge of the present operations. All of these blows are within $1\frac{1}{2}$ miles of the Nowa Nowa railway station, and two of them are now being opened out.

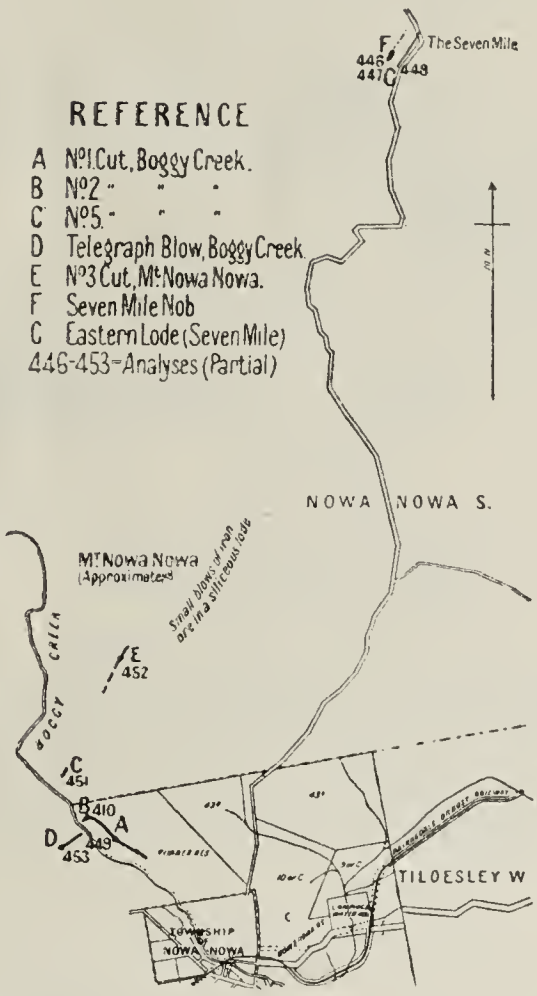


Fig. 113. Locality plan—Nowa Nowa to the "Seven Mile."
Scale : 2 miles to 1 inch.

No. 1 Cut, Boggy Creek ("A" on Locality Plan).

This cut is on the east side of Boggy Creek, and shows a blow of medium specular iron ore (hematite), which was about 14 feet wide at the surface, narrowing to a few feet going down (Fig. 114).

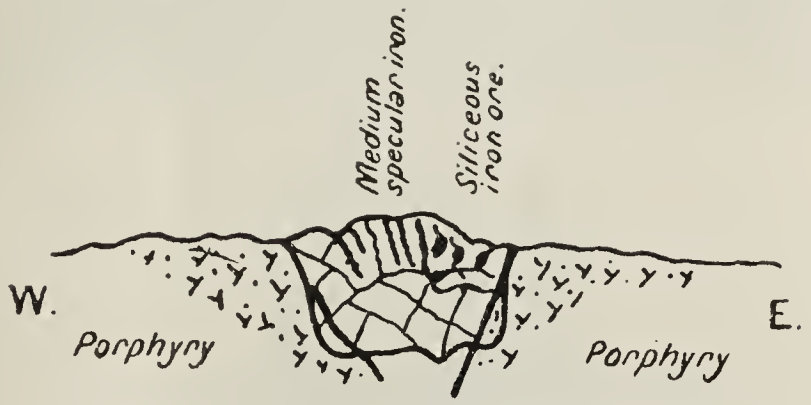


Fig. 114. No. 1 Cut, Boggy Creek.
Scale : 20 feet to 1 inch.

The outcrop was somewhat siliceous, but improved to dense hematite as sunk on. This ore body appears to be a blocky lens, and does not indicate the presence of a large body of iron ore. A sample was taken across the cut (assay No. 449).

No. 2 Cut Boggy Creek ("B" on Locality Plan).

This cut is on the east side of Boggy Creek, and exposes a body of medium specular iron and dense hematite ore with porphyry walls. In

shape, the iron lens is curved and stumpy on the west end, but tapering to about 1 foot or less on the east end, where it runs into the main siliceous banded lode. (Fig. 115.)

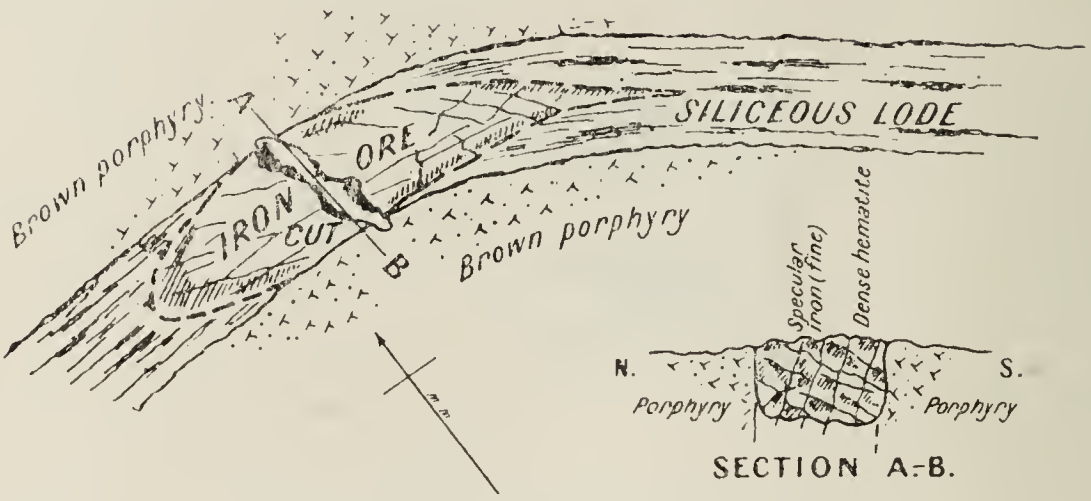


Fig. 115. Plan, No. 2 Cut, Boggy Creek.
Scale : 40 feet to 1 inch.

The lens measures about 70 feet in length, 15 feet wide in the middle, and should go down for at least 20 feet, as the west end at its lowest outcrop is about that much below the highest point on the east end.

The iron ore was sampled at intervals of 1 foot across the cut (assay No. 450).

No. 5 Cut, Boggy Creek ("C" on Locality Plan).

No. 5 cut is about a quarter of a mile north-west of No. 2 cut, and on the eastern side of Boggy Creek. A small blow of 5 feet in width shows very dense hematite. The ore is magnetic, and possibly contains an admixture of magnetite. The containing rock is a green felsite running with the lode north-easterly through the main porphyry. Fig. 115 shows that the iron here occurs in two narrow makes parted by 2 feet of green felsite rock. Within a few chains west of No. 5 cut there are outcrops of a siliceous banded lode, showing streaks of specular iron ore. Both of these lodes trend north-easterly, and have no connexion with the main Boggy Creek siliceous lode, which strikes north-westerly.

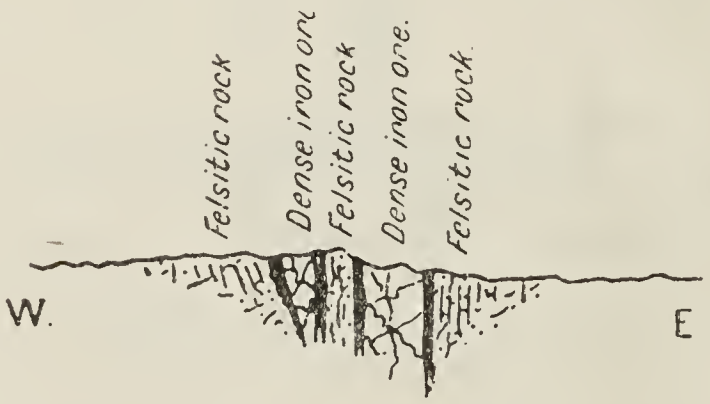


Fig. 116. No. 5 Cut, Boggy Creek.
Scale : 20 feet to 1 inch.

An average sample of the ore was taken (assay No. 451).

Telegraph Lode, Boggy Creek ("D" on Locality Plan).

The Telegraph lode is on the western side of Boggy Creek, and about $1\frac{1}{4}$ miles from Nowa Nowa railway station. Quartz and jasper, with narrow veins or banding of specular iron, comprise the main portion of

this 20-ft. lode, which can be traced from the top of the spur right to Boggy Creek. It is similar in structure to the large lode on the eastern side of Boggy Creek, and at one time may possibly have been connected with it, although the strike is different.

Fig. 117. Telegraph Lode, Boggy Creek.
Scale : 40 feet to 1 inch.

Where this lode crops on top of the spur, a 10-ft. blow of specular iron ore occurs, having siliceous and jasperoid banding on both sides, making about 20 feet in all (Fig. 117). This blow of iron has a certain amount of siliceous mineral assocoiated with it, and appears to be about 30 feet in length, but it has yet to be prospected. A sample taken from a surface blow, 10 feet wide by 4 feet high, shows medium specular iron (assay No. 453).

Mt. Nowa Nowa Area.

No. 3 Cut, at Foot of Mt. Nowa Nowa ("E" on Locality Plan).

At the foot of Mt. Nowa Nowa, on the southern slope, and about two miles northerly from the railway station, an old cut has exposed about 8 feet of good specular iron and dense hematite associated with jasper and siliceous bands, veined with a small amount of iron ore. Recent prospecting by open cut has exposed 16 feet of rich iron ore, broken at the surface by jasper and siliceous banding, and a portion of fault rock, which has pinched out, going underfoot at 10 feet.

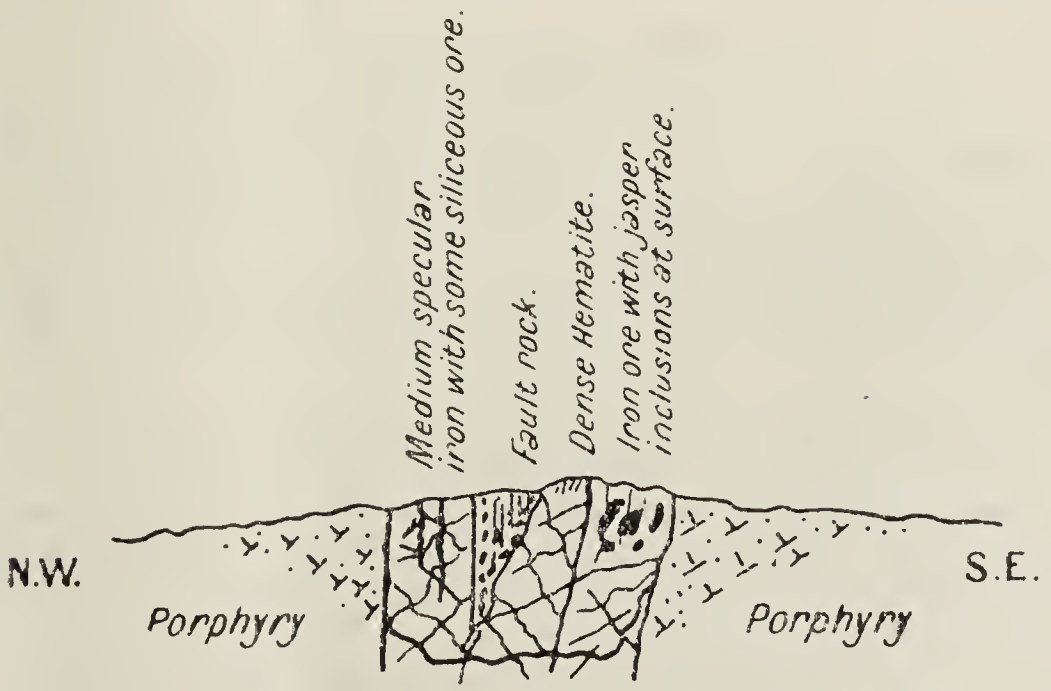


Fig. 118. No. 3 Cut, Mt. Nowa Nowa.
Scale : 20 feet to 1 inch.

The ore is mainly specular iron, but there is on the south-east wall some dense hematite (magnetic, possibly or account of an admixture of magnetite). The surface outcrop was siliceous, and had much jasper associated with the iron ore, but on sinking the ore improved considerably.

A 4-ft. blow of iron ore outcrops about midway between the old cut and the No. 3 cut, pointing to continuity of the ore, which would probably be a lens-shaped body (Fig. 119). This Mt. Nowa Nowa lode appears to be a siliceous banded lode channel, with lenses of rich iron ore at intervals. It appears to bend slightly east past the cuts, and a strong siliceous lode can be followed north-easterly for many chains across the eastern slopes of Mt. Nowa Nowa. Southerly the lode is said to continue to Boggy Creek, but the heavy surface soil is likely to hamper prospecting. To the east of this lode another parallel lode occurs lower down the hill slope, but only small outcrops are visible.

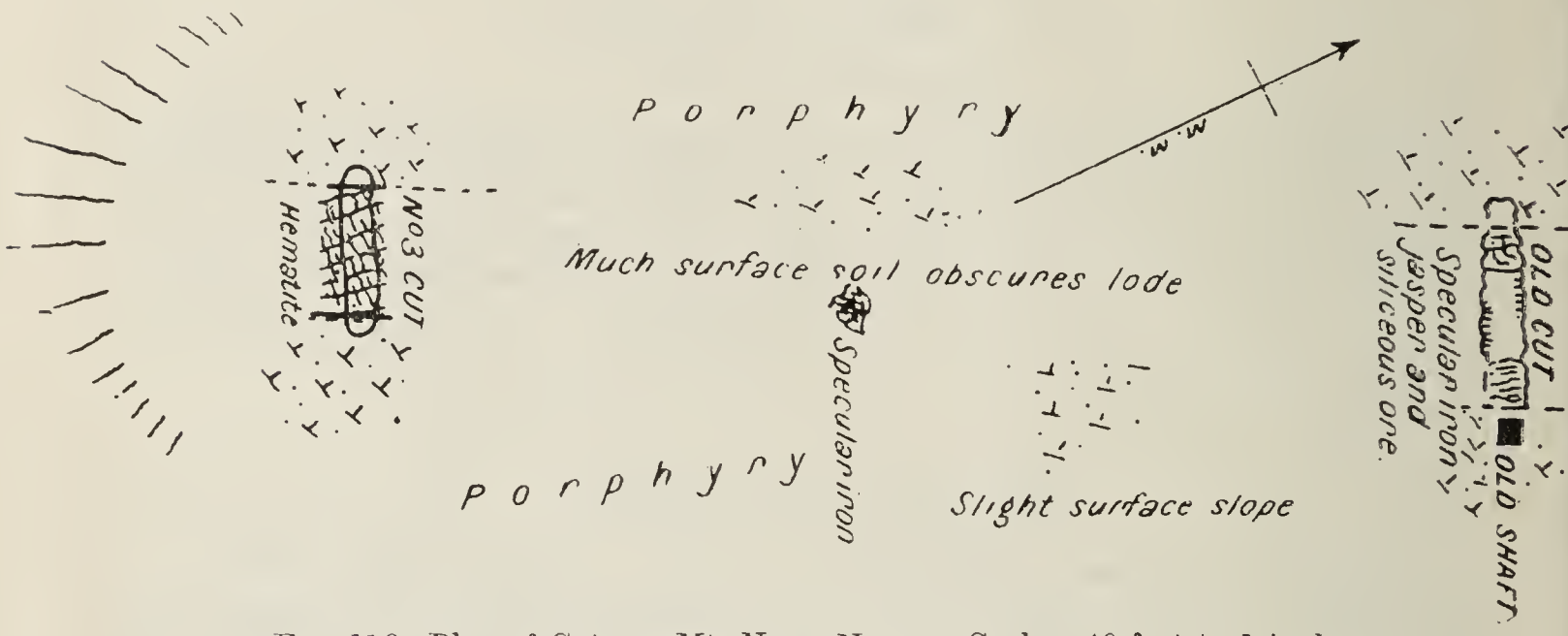


Fig. 119. Plan of Cuts on Mt. Nowa Nowa. Scale : 40 feet to 1 inch.

Prospecting south of No. 3 cut would prove the continuity and value of the iron lens in that direction, and enable the best site for prospecting at a depth to be selected.

An average sample of the iron ore in No. 3 cut was obtained (assay No. 452).

Seven Mile Area.

Seven Mile Nob ("F" on Locality Plan).

At 7 miles north of Nowa Nowa, on the west side of the Buchan road, iron ore occurs in porphyry rock on the north-easterly extension of the Mt. Nowa Nowa iron belt.

The main ore body measures 130 feet wide by 250 feet long, constituting the largest body of hematite ore yet found in the district. (Fig. 120.)

A cut 15 feet wide by 5 feet deep on the south-east wall exposes dense clean hematite ore, which was sampled (assay No. 446).

An average sample was not taken over the whole nob, as loose iron ore and soil mask portion of the solid ore body. A fair sample taken by H. C. Jenkins in 1900 gave—Fe, 59.85 per cent.; Sio_2, 13.25 per cent.; Mg, nil; P_2O_5, nil; and S, trace.

The cut is 15 feet below the crest of the nob, and old workings adjacent and 10 feet lower show that the ore will extend at least to 25 feet or 30 feet.

At 60 feet below the crest of the nob, and about 5 chains easterly from it, a lode of hematite ore is seen, and may fairly indicate that the iron nob ore will possibly continue to 50 feet in depth or even more; but a 60-ft. shaft in the porphyry wall with a north-western cross-cut would definitely prove the continuity, size, and value of the ore body at a depth.

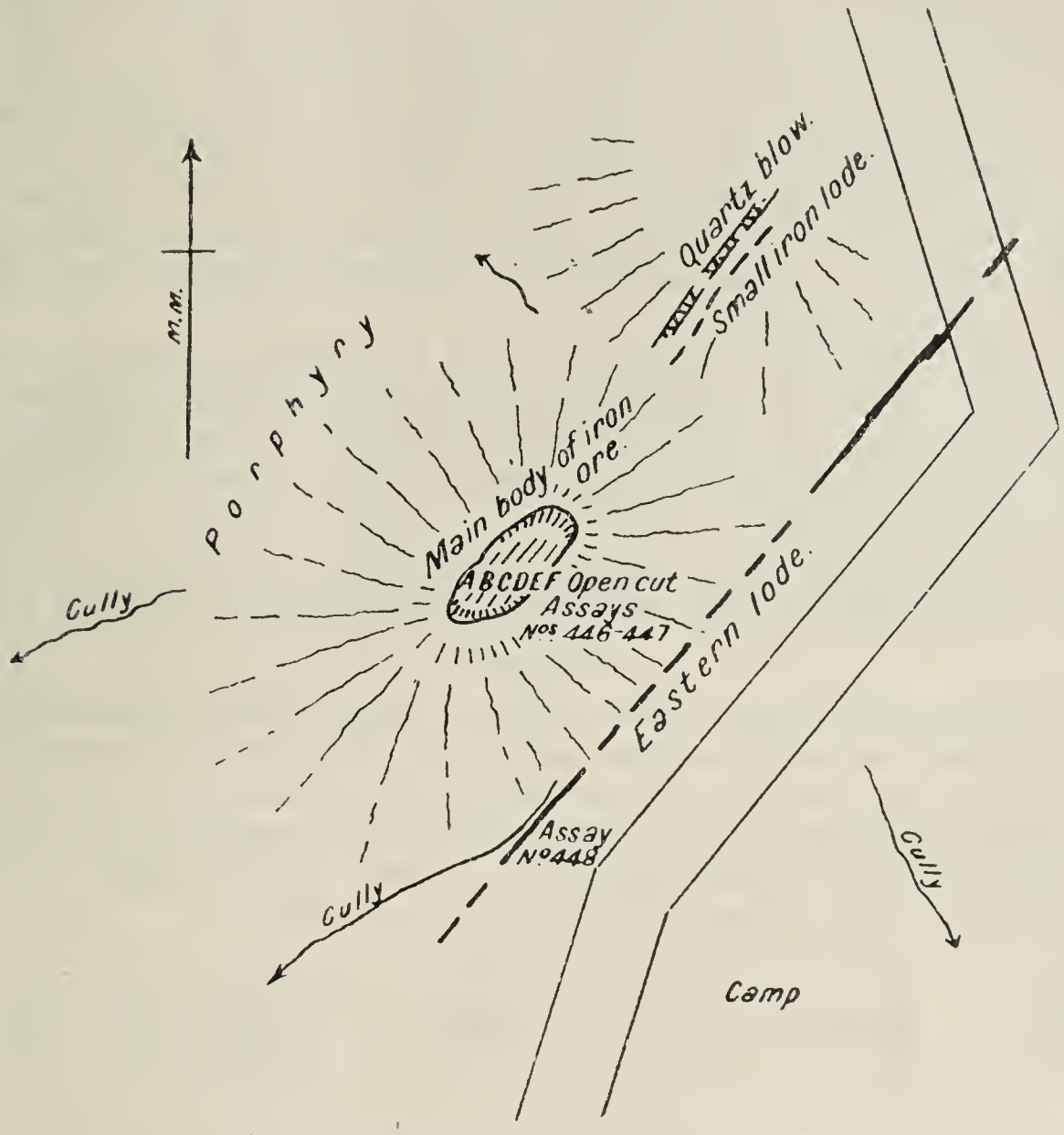


Fig. 120. Plan of "Seven Mile" Nob.
Scale: 8 chains to 1 inch.

A general description of the ore throughout the nob going from north-west to south-east is—

a. Coarse specular iron and micaceous hematite.
b. Medium specular iron (hematite).
c. Siliceous iron ore and banded quartz.
d. Medium specular iron (hematite).
e. Dense hematite (magnetite association in part).
f. Spotted siliceous hematite ore (magnetite association in part).

Besides the central silification, there is a certain amount of fine quartz veining and silica in other portions of the iron ore on the knob.

The Eastern Lode, Seven Mile ("G" on Locality Plan).

The Eastern lode had up to recently not been traced south-westerly from its outcrop on the road, and it has not yet been prospected. From the surface outcrops, which are little exposed, there should be at least over 5 feet of mixed hematite and siliceous iron ore over many chains in length, but prospecting cuts may prove the lode to be of greater width. A sample from one of the outcrops was obtained on the south-west end. (See Fig. 120.) (Assay No. 448.) On the adjacent hill to the north there are surface blows of a siliceous banded iron lode several feet in width, and unprospected.

General.

On the whole, the iron ore may be said to occur as lens-shaped bodies in well-defined banded siliceous lode channels, which traverse a belt striking north-easterly through porphyry rocks, showing much jasper where the richer iron lenses occur. The dip of the lodes is more or less vertical as far as can be seen at present.

The quantity of commercial iron ore in any of the lodes cannot be estimated until further work at a depth is carried out. The largest known body of hematite ore occurs at the " Seven Mile " nob, and further prospecting on the south end of Mt. Nowa Nowa (No, 3 cut) may prove a considerable quantity of high-grade ore. At No. 2 cut on the Boggy Creek lode the ore is of high value, and close to Nowa Nowa station, but this lens-shaped body of ore appears to be of limited extent. Besides the above, other iron blows along the siliceous lode channels remain to be prospected.

The lodes have not yet been proved in depth, and this remains to be done by shafts and cross-cuts or tunnelling where convenient. It is possible that some of the more siliceous iron ore may improve with depth, while on the other hand some of the richer ore may become siliceous as opened up.

The analyses show that there is much silica in some of the ore, but in some cases blending may overcome the difficulties of smelting such ore.

Analyses.

The following analyses were made at the Geological Survey laboratory on fairly average samples personally obtained. The best results are from the ores at the "Seven Mile," Mt. Nowa Nowa (No. 3 cut), and Boggy Creek lode (No. 2 cut). The unprospected Eastern lode at the " Seven Mile " is promising. Nos. 1 and 5 cuts, Boggy Creek, and the Telegraph blow, Boggy Creek, give low values.

Assay No.	Field No.	Class of Ore.	Locality.	Iron (Fe).	Silica (SiO_2).	Phosphorus (P).	Sulphur (S).
				%	%	%	%
446	1	Dense hematite (some magnetite)	"Seven Mile" Nob, north of Nowa Nowa	63·6	6·43	Slight trace	0·14
447	2	Dense hematite (partly siliceous)	"Seven Mile" Nob, north of Nowa Nowa (eastern wall)	50·7	26·22	Trace	0·12
448	3	Dense hematite, medium specular iron and siliceous ore	Eastern lode at the " Seven mile "	52·0	24·00	Trace	0·10
449	4	Medium specular iron with siliceous ore	No. 1 cut, Boggy Creek lode	33·4	53·30	Slight trace	0·11
450	5	Dense and medium hematite (slightly siliceous)	No. 2 cut, Boggy Creek, N.W. lode	65·0	8·63	Trace	0·12
451	6	Dense hematite (with associated magnetite (?))	No. 5 cut, Boggy Creek, N.E. lode	49·8	26·57	0·07	0·13
452	7	Dense hematite (with magnetite (?)) and specular iron	No 3 cut, south foot of Mt. Nowa Nowa	62·3	7·75	0·05	0·14
453	8	Medium specular iron with siliceous ore	Telegraph blow on west side of Boggy Creek	34·8	49·61	Slight trace	0·10

FERRUGINOUS MANGANESE ORE, MOUNT TARA, NEAR BUCHAN.

By J. P. L. Kenny, B.C.E.

Lode outcrops of ferruginous manganese ore occur on the Mount Tara range in the Snowy River porphyries, volcanic beds of Lower Devonian age. The areas described in this report are held under mineral leases 3,937 and 3,942, parish of Buchan, and lease 3,943, parish of Nowa Nowa. The localities are five miles apart, and small outcrops occur in the intervening country, but no work has been done upon them.

The northern area (leases 3,937 and 3,942) now held by Messrs. Lee and Eaton, includes portion of allotment 10A of D, parish of Buchan, and the lodes extend south-westerly into the State Forest. On the south boundary of allotment 10A three lode outcrops cross the fence. On the two easterly lodes a little work has been done. The outcrops are from 2 feet to 6 feet wide, carrying oxides of iron and manganese. From the western of these two lodes, three samples were taken and assayed at the Mines Department laboratory, and from the eastern lode one sample was taken. Sample No. 1 (Assay No. 513) was broken from an outcrop 2 ft. 6 in. wide. Samples No. 2 and 3 (Assays No. 514 and 515) were taken from stone at grass from a shallow shaft, from heaps of 1 ton and 2 tons respectively. Sample No. 4 (Assay No. 516) was taken from an outcrop 2 feet wide, on the eastern lode. These samples gave the following results:—

Assay No.	Iron (Fe).	Manganese (Mn).	Sulphur (S).	Phosphorous (P).	Silica (SiO_2).
	%	%	%	%	%
513	5·25	34·2	0·06	0·02	25·64
514	11·65	34·4	0·10	0·03	15·29
515	6·20	40·9	0·06	0·04	11·06
516	3·63	40·1	0·04	0·03	8·99

A shaft has been sunk on the eastern lode at a point 475 links south of the south boundary of allotment 10A. This shaft is sunk in a body of soft haematite with nodules of hard manganese dioxide. A sample of the material passed through in the shaft was taken from the mullock on the surface and tested as a pigment. The report on this sample, No. 5 (Assay No. 517), is given below:—

Assay No.	Iron (Fe).	Manganese (Mn).
	%	%
517	53·68	1·3

No. 517.—*Pigment Test.*—Sample consisted of a soft earthy purple brown oxide mixed with hard manganese oxide and ferruginous grit. The earthy pigment was separated from the gritty portion by a levigation process in the following proportion—

Coarse hard gritty matter	58	per cent.
Fine levigated pigment	42	,,
Total	100	,,

A portion of the washed pigment, after drying, was calcined at a dull red heat. The raw and burnt pigments were made into paints and tested for colour, covering power and staining properties.

——	Raw.	Burnt.
Colour	Maroon	Maroon
Covering power	Very good	Very good
Staining power	Good	Good
Iron content (Fe_2O_3)	76·76 per cent.	..
Manganese oxide (MnO_2)	2·15 per cent.	..

The levigated pigment is a rich purple-brown oxide and would probably be classed as an Indian red. It would be of value for the preparation of dark roofing paints and for tinting coloured oil paints.

As far as can be judged by the surface indications, earthy oxide similar to the sample tested can be obtained in quantity. Hard nodules of ferruginous manganese oxide occur in the earthy oxides; a sample, No. 6 (Assay No. 518), was assayed, and gave the following results:—

Assay No.	Iron (Fe).	Manganese (Mn).	Sulphur (S).	Phosphorus (P).	Silica (SiO_2).
	%	%	%	%	%
518	23·35	35·0	0·06	0·02	5·91

The second area on which work has been done is two miles south-east of the racecourse reserve, parish of Nowa Nowa. A lode outcrop has been traced for a distance of 15 chains in a north-easterly direction, up a spur with a slight rise. On the north end the lode outcrop is 50 feet wide, consisting of limonite, with oxides of manganese. A three-compartment shaft, 10 feet by 4 feet, has been sunk on the outcrop. I was unable to examine the underground workings, as the framework of the shaft had been destroyed by a bush fire, but I was informed that the shaft was 100 feet deep, with cross-cuts 60 feet east and 50 feet west at 50 feet, and a cross-cut 70 feet west at 100 feet, and also drives north and south at both levels. Two samples were taken from this outcrop. Sample No. 10 (Assay No. 523) was taken 15 feet west of the shaft, and sample No. 11 (Assay No. 524) was broken right across the outcrop. These samples gave the following results:—

Assay No.	Iron (Fe).	Manganese (Mn).	Sulphur (S).	Phosphorus (P).	Silica (SiO_2).
	%	%		%	%
523	47·06	13·9	Slight trace	0·015	4·23
524 ..	46·72	13·0	,,	0·02	6·11

About 2 chains north of the shaft this outcrop appears to pinch out. Two and a half chains south-east of this shaft the lode outcrop is 20 feet wide, and 5 chains south it is 30 feet wide. A prospecting shaft, about

20 feet deep, has been sunk on the eastern side of this outcrop. A sample, No. 8 (Assay No. 521), of the material from this shaft gave:—

Assay No.	Iron (Fe).	Manganese (Mn).	Sulphur (S).	Phosphorus (P).	Silica (SiO_2).
	%	%	%	%	%
521	37·80	10·0	0·05	0·03	19·30

South of this prospecting shaft the lode appears to be faulted about 50 feet to the south-east, where an outcrop 15 feet wide shows. Beyond this point the lode on the surface consists of a number of small bands of hard ironstone.

On the south end of the outcrop a shaft, known as the No. 1 shaft, has been sunk. The shaft is not now accessible, but I was informed that it was 70 feet deep, with levels at 40 feet and 70 feet. At the 40-ft. level there are drives 13 feet north and 18 feet south. At the 70-ft. level there is a drive north for 38 feet. At 24 feet in this drive there are cross-cuts 32 feet east, and 10 feet west. From the shaft there is a drive south, of 19 feet, and a cross-cut east, 18 feet. At the mouth of this shaft a heap of about 2 tons of kidney iron ore is at grass. An average sample, No. 7a (Assay No. 520), of the ore from this heap gave the following results:—

Assay No.	Iron (Fe).	Manganese (Mn).	Sulphur (S).	Phosphorus (P).	Silica (SiO_2).
	%	%		%	%
520	56·47	2·7	Trace	0·04	5·21

The analyses indicate that in leases 3,937 and 3,942 marketable ore could be obtained from lodes 2 feet to 3 feet wide. The red oxide from the shaft on lease 3,942 may be developed as a pigment.

The nodules of oxide of manganese contained in the red oxide would supply a limited quantity of maganese ore of good quality. On lease 3,943, near the race-course reserve, the assays indicate that the lode formation, as a whole, does not carry a high percentage of manganese, and could not be worked for manganese as an open cut. Possibly lenticles of ore of good quality occur in the underground workings. The ore at grass from the south shaft on lease 3,943 is haematite, with a small percentage of manganese. The present cost of carting from the mine to Nowa Nowa railway station would be about 35s. per ton. With a road between the mine and the main road this could be considerably reduced. A recent London quotation for manganese ore is 1s. 1d. to 1s. 2d. per unit for ore containing 48 per cent. to 50 per cent Mn. (*Metal Bulletin*, London, 5th May, 1922). Prices are subject to deductions for impurities if present in excess of the quantities mentioned below:—

Silica if over	8	per cent.
Iron ,, ,, ...	4	,, ,,
Phosphorus	1	,, ,,

With one exception, none of the samples of which analysis are given above approach this standard. The last work on this lode was done by the Victorian Manganese Mines Iron and Steel Company, formed in

1909, with a capital of £120,000. This company put down the main north shaft on lease 3,943. Only one yield is recorded in the Mines Department returns in 1910:—3½ tons of ore, valued at £42.

Barytes.

Shall outcrops of barytes occur on lease 3,943, and a picked sample assayed at the Mines Department Laboratory gave 91.58 per cent. of barium sulphate. No work has been done on these outcrops, and the surface is discoloured by oxide of iron.

[23.6.22.]

IRON ORE AT LANGWARRIN.

A. M. Howitt.

On allotment 20, parish of Langwarrin, there are deposits of limonite (oxide of iron) occurring along the sides of the main gullies.

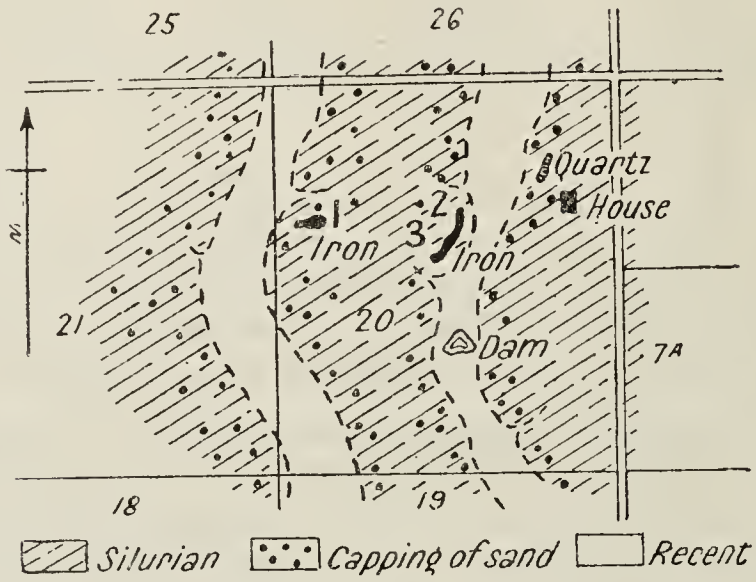


Fig. 121. Plan.
Scale: 40 chains to 1 inch.

An outcrop in the north-west corner of the allotment has been opened by a shallow cut 15 feet by 3 feet by 3 feet). Here the iron ore occurs in semi-rounded kernels of limonite in a siliceous tertiary ironstone, and would be of little value as a source of iron. A sample taken was analysed at the Geological Survey Laboratory, and gave:—No. 517. Fe = 33%; Fe_2O_3 = 47.1%.

Better ore may occur beneath, but the lateral extent is likely to be limited as the adjacent slopes show silurian sandstones, quartzites, and shales cropping through the surrounding sands. This silurian area is not marked on the geological map of Victoria.

Another outcrop for several chains fringes the western side of the main gully, running through allotment 20, and opposite Mr. Smith Macdonald's house. As exposed, it is about 2 feet thick, and appears

to be a better class of ore, but here, also, the quantity would be limited. Samples analysed gave:—

No.	Fe.	Fe_2O_3.
	%	%
518	48·6	69·4
519	47·6	68·0

Most of the adjacent hills show silurian rocks, with a capping of tertiary sands, &c., and the two iron outcrops do not appear to be connected.

The iron ore would be too limited in quantity to be of value as a source of pig iron. I am informed that road metal is scarce in the district, and both the iron ore and quartzite would be worth considering for this purpose.

[24.5.20.]

SCHEELITE AT KOETONG.

By J. G. Easton.

The whole of the scheelite deposits near Koetong occur in granite. Keady's leases, Nos. 298 and 3,110, containing 8 a. 3 r. 8 p. and 66 a. 3 r. 3 p. respectively, are situated in the vicinity of the north boundary of allotment 37b, parish of Koetong, and 3½ miles north of the township of Koetong.

Most of the work in these leases has been done by means of shallow shafts and costeans, which extend at intervals for 260 feet along an east and west line. At the west end of the line the reef was worked to depth of about 30 feet on the underlay, which is about 40° south at the surface, but nearer vertical in the bottom of the shaft. This shaft has fallen in. Mr. Keady informed me that two bags of tin ore were obtained from near the surface, but in the bottom the tin gave place to scheelite; the reef was here about 18 inches wide. At 60 feet further east another shaft 10 feet deep cut the reef, which averaged about 9 inches thick. An assay gave 11.9 per cent. tungstic acid, according to Mr. Keady. At 120 feet east a costean has been opened up along a peculiar gneissose formation ranging up to 4 feet wide and carrying traces of scheelite. The costean is 35 feet long and up to 5 feet deep. At its eastern end is a quartz lode with a soft decomposed formation of fine-grained tourmaline, and another black mineral on the footwall, carrying tin and dipping 30° south-west. This formation, although on approximately the same strike, does not appear to be the continuation of the deposit worked at the western end of the line. Lying on the surface at the time of my visit was about 5 tons of ore, consisting of white, yellow and reddish scheelite, in gneissose rock and quartz.

At the eastern end of the line a small prospecting shaft 6 feet deep exposes a quartz reef dipping 35° south, averaging about 12 inches wide, and carrying patches of scheelite. To the north of this line of workings, several small quartz spurs carrying scheelite have been opened at the

surface. The only spur of workable size is about 3 chains north-east of the main line, and immediately outside of the lease; it is a flat make carrying tin and scheelite, and has been exposed up to 3 feet in width, but is only a surface show.

Scheelite has also been found in two outcrops about 20 chains north-west from these workings, but they have not been opened up.

Nyman's workings are on Mildren's No. 3 reef, which is shown on the geological plan of the parish of Granya, in allotment 47, about $3\frac{1}{4}$ miles south-west of Koetong. The reef consists of a mixture of quartz, felspar, tourmaline, arsenopyrite and scheelite. It strikes north 3° west, and dips from 40° to 45° east in decomposed granite. In places quartz carrying scheelite predominates, but generally the reef consists of soft decomposed tourmaline, felspar and quartz, with patches and veins of scheelite disseminated throughout. In Nyman's claim it varies from a few inches up to 15 inches wide, averaging about 9 inches, and has been proved by shafts and drives for a length of 140 feet, and to an average depth of 15 feet.

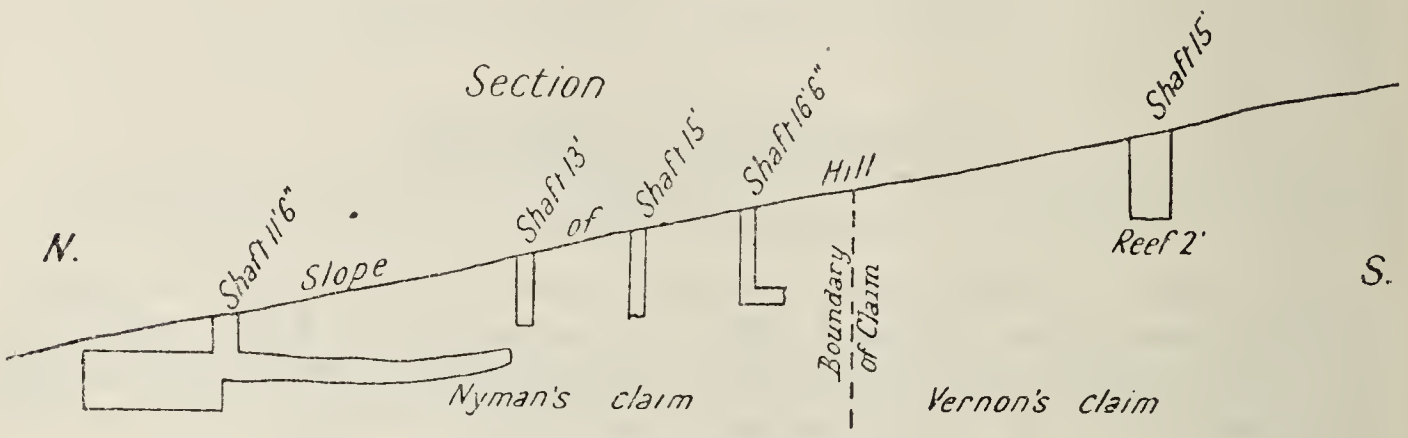


Fig. 122. Section.
Scale: 60 feet to 1 inch.

About 10 tons of ore was hand-crushed, sluiced, and then treated with the plunger to purify the concentrates, which amounted to $16\frac{1}{2}$ cwt. of scheelite, assaying 70 per cent. of tungstic acid. This parcel was sold for £135 net. About 40 tons of ore now at grass, and another 160 tons in sight is considered by Mr. Nyman to be of the same quality.

Miners' right claims have been pegged out north and south of Nyman's. To the south, Vernon has opened the lode to a depth of 15 feet, proving the lode to be over 2 feet wide in the bottom, and dipping 40° east. He has about 5 tons of ore at grass.

Three-quarters of a mile to the north, Lewis and party have pegged out a lease of about 80 acres, including all the old workings known as Mildren's No. 1 reef, which was worked for tin some years ago. Several shallow shafts were sunk along this line, which strikes north-west, and has a northerly dip. These workings are now accessible, but traces of scheelite can be found in the surface rocks.

About 4 chains to the north Mr. Lewis has opened for 12 feet along the surface a small reef, which strikes north 70° west, and dips north-east. The reef is from 6 inches to 15 inches wide, and carries occasional patches of scheelite in the solid, and a small vein along the footwall. There is here about 2 cwt. of ore at grass.

Coughlan and party are operating on Mildren's No. 2 reef, about half a mile further north-west, near the south boundary of allotment 34, parish of Granya. This formation was first worked for tin by H. Mildren, and later by the Border Tin Mining Company. Scheelite,

wolfram, arsenopyrite and traces of gold were also obtained. The quarry-like workings have fallen in, so that very little is to be seen, but scheelite is said to continue underfoot in spurs and veins of quartz.

About 100 feet north-east of the original workings, which strik north 30° west, Coughlan and party have also sunk an underlay shaft for 20 feet on a formation striking about east and west. It varies from a few inches up to 12 inches in thickness, and is chiefly composed of fine acicular crystals of tourmaline in quartz with occasional quartz veins and felspar. A patch of cassiterite was worked at the surface; such patches have been found in most of the lodes. A new vertical shaft is now being sunk to cut the formation at a depth of about 47 feet, but the granitic rock has become very hard at about 20 feet. The lode has also been opened on the hillside, about 30 feet further east, where it is small. About 2 tons of scheelite ore now on the surface does not look as rich as Nyman's.

I regard all the claims except Nyman's, as merely in the prospecting stage, and consider that further work is necessary before an estimate of available ore can be made.

Nyman has about 200 tons of ore in sight, including the 40 tons at grass, with every indication of further supplies. The ore is soft and easily milled. Nyman has purchased a small machine for dry crushing, and expects to have it on the ground in a few days.

During the last three years Keady has taken about £70 worth of tin and scheelite from his claim, and now has about 10 tons at grass, which shows fair prospects of scheelite. The limited amount of work done makes it impossible to estimate the quantity or value of ore likely to be opened up.

Coughlan's and Lewis' claims are not sufficiently developed for any estimate of available ore to be made.

[27.11.15.]

MOLYBDENITE AT YEA.

By B. D. Mitchell.

The molybdenite occurrences now being prospected by J. H. Connor and party are situated about 8 miles south-east of Yea.

No. 1 formation is being opened up on top of a soft granite saddle 300 feet to 400 feet above the valley. A small shaft 6 feet deep shows a vertical quartz vein 4 inches to 6 inches wide with other small veins in the hanging wall country, all carrying a little molybdenite. The formation has been traced along the ridge for about 300 yards north 30° east. The shaft is in soft granite, and if continued should prove the ore values in depth.

No. 2 formation, about a mile farther east, consists of a large hard granite outcrop carrying massive quartz veins and showing fair prospects of molybdenite. It is being prospected by a small drive in hard country and the ore indications are promising. To prove its continuation, it should be tested by a wide open cut face.

No. 3 formation, in Monkey Gully, about a quarter of a mile east of No. 2, is a similar occurrence, showing fair ore values in massive quartz and mica. This can be proved more cheaply by the open cut system than by driving.

Considering the very small amount of prospecting in the locality and the promising indications, the ventures certainly warrant further development.

[1.3.20.]

MOUNT DOUGLAS MOLYBDENITE MINE, KORONG VALE.

By O. A. L. Whitelaw.

Messrs. Napier and Wilkinson's workings (lease No. 3,541) are situated in the south of the parish of Kinypanial on property held by Mr. John Curnick, about 4½ miles east of the Korong Vale township.

The rock in which the molybdenite veins occur is primarily a fairly coarse-grained biotite mica granite through which occur masses of muscovite-mica granite. A secondary silicification of the muscovite-bearing rock mass has occurred, and the final stage of this alteration appears to have been the deposition of small quartz veins along the joint planes of the granite. The joint planes strike north 28° west and are practically vertical. The molybdenite is associated with these quartz veins, and may also be obtained occasionally in siliceous vughs in the granite.

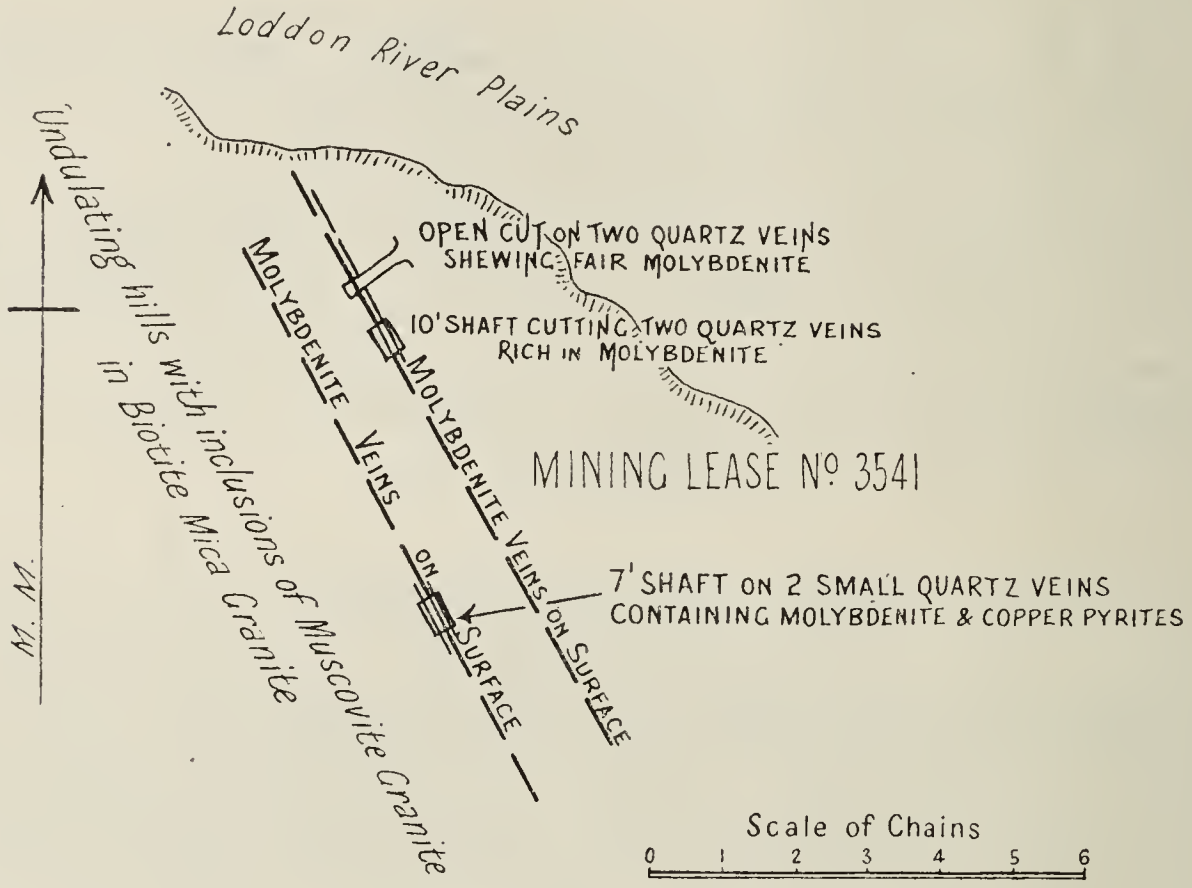

Loddon River Plains
Undulating hills with inclusions of Muscovite Granite in Biotite Mica Granite
OPEN CUT ON TWO QUARTZ VEINS SHEWING FAIR MOLYBDENITE
10' SHAFT CUTTING TWO QUARTZ VEINS RICH IN MOLYBDENITE
MOLYBDENITE VEINS ON SURFACE
MINING LEASE Nº 3541
7' SHAFT ON 2 SMALL QUARTZ VEINS CONTAINING MOLYBDENITE & COPPER PYRITES
Scale of Chains
0 1 2 3 4 5 6

FIG. 123. Sketch plan.

The workings consist of two shafts and a deep trench. The most southerly shaft is about 7 feet in depth and opens up three small veins of quartz from ½ inch to 2 inches in thickness. Molybdenite and copper pyrites are well disseminated throughout the quartz veins, to which they are practically confined. These veins can be traced along the surface for several chains in both directions, and molybdenite shows freely throughout. No. 2 shaft, 250 feet north of No. 1, has been sunk to about 10 feet, and has cut two veins of quartz which are about 80 feet east of those cut in No. 1 shaft. The larger of these veins is about 3 inches in thickness and very rich in molybdenite, the vein channel being in places almost entirely replaced by ore. These two veins have also been cut in the trench to the north and show molybdenite spangles freely. They can also be traced north to the Loddon River Plains, and south for several chains, with ore showing wherever the veins are visible through the granite.

The work done on this lease demonstrates that very rich molybdenite occurs in the quartz veins and that the ore bodies have considerable length, but that they are very restricted in width, and the joints carrying the veins are rather widely separated.

The developments certainly warrant further prospecting, and to carry this out I would suggest that No. 2 shaft be sunk on the rich ore an additional 50 feet, levels put 50 feet north and south on the ore channel, and a cross-cut west about 80 feet cutting the lines in No. 1 shaft, and anything that may occur in the intervening country.

At several localities for about 3 miles south of Napier's mine specks of molybdenite may be seen in quartz veins. Sufficient work has not yet been done upon them to indicate if they are of any value.

[7.11.19.]

MOUNT DOUGLAS MOLYBDENITE MINE, KORONG VALE.

By H. S. Whitelaw.

A report was made at the end of 1919 when there were two shallow shafts and a trench in the ground now held under lease by the Mount Douglas Syndicate on a tongue of granite that, on its northerly trend from Mount Korong, is about to dip under the Loddon Valley plains between 4 and 5 miles east of Korong Vale township.

Since the formation of this syndicate, that is, during the last twelve months, what is known as No. 2 shaft has been deepened from 10 feet to between 30 and 40 feet, and No. 3 shaft, between 2 and 3 chains westward, has been sunk to about the same depth. In the former shaft the ore, which was rich at the surface, is richer at the bottom; in the latter it is of good average sample throughout. In both it is narrow, and by reason of that it is doubtful whether in the present stagnant state of the market the syndicate can profitably pursue its operations. At the same time insufficient work has been done even to indicate the potential resources of the property. Energy has been concentrated on the two outside north-and-south veins (which are more or less parallel in strike and vertical in dip) to the neglect of that strip—roughly 150 feet wide—that intervenes. In this the granite is of peculiarly varied composition and texture, contains numerous cross quartz veins, and has disseminated through it a percentage of molybdenite and other sulphides.

It is not suggested that this is the ore channel proper, but there are superficial indications, in the decomposed portion of the belt between the two lines, of the existence of other runs of ore. The discovery of an additional one or two of value equal to those already opened up would be justification for embarking on a vigorous policy of development. A cross-cut west from the bottom of No. 2 shaft, after it has been deepened, say, another 50 feet, would probably prove to be the best means of opening the rocks in question and of ascertaining the value of the holding above water-level.

[24.11.21.]

Following a suggestion contained in a brief report forwarded by me to head office on 26th November, 1921, No. 2 shaft on the Mount Douglas Molybdenite Lease (3541 M.) has been sunk to within a couple of inches of 60 feet below sill. There is no noticeable difference in the appearance or value of the vein as seen in the then bottom and the present bottom of the shaft. At about 53 feet below the surface, sinking revealed a splash of mixed sulphides over a width of about 6 inches, a sample from which, when tested, contained copper, iron, bismuth and molybdenite. An assay for gold and silver indicated a content of 12 gr. and 42 oz. 6 dwt., respectively, to the ton. From the bottom of the shaft a cross-cut (called the 60-ft. level) has been driven a distance of 24 feet westerly. In this the continuation of a joint, carrying at the surface 3 inches of quartz bearing 8 per cent. of molybdenite, was intersected at 10 feet from the shaft. Here associated with it is a mere thread of quartz containing a trace of molybdenite. On either side, 12 inches over all, the bounding granite is peppered with the latter mineral. At 4 feet further in a 1-in. vertical pug seam, which the miners named "the cross-course," was met with. This strikes 10° or 11° west of south, and runs with a wall that, being comparatively easy to shoot to, is being driven on. The face of the drive on 26th April, 1922, was 7 feet south of the cross-cut. There has been movement along this wall which apparently has connexion with the southerly-striking dyke stone shown on the accompanying plan of lease. It is intended to extend the drive to the downward continuation

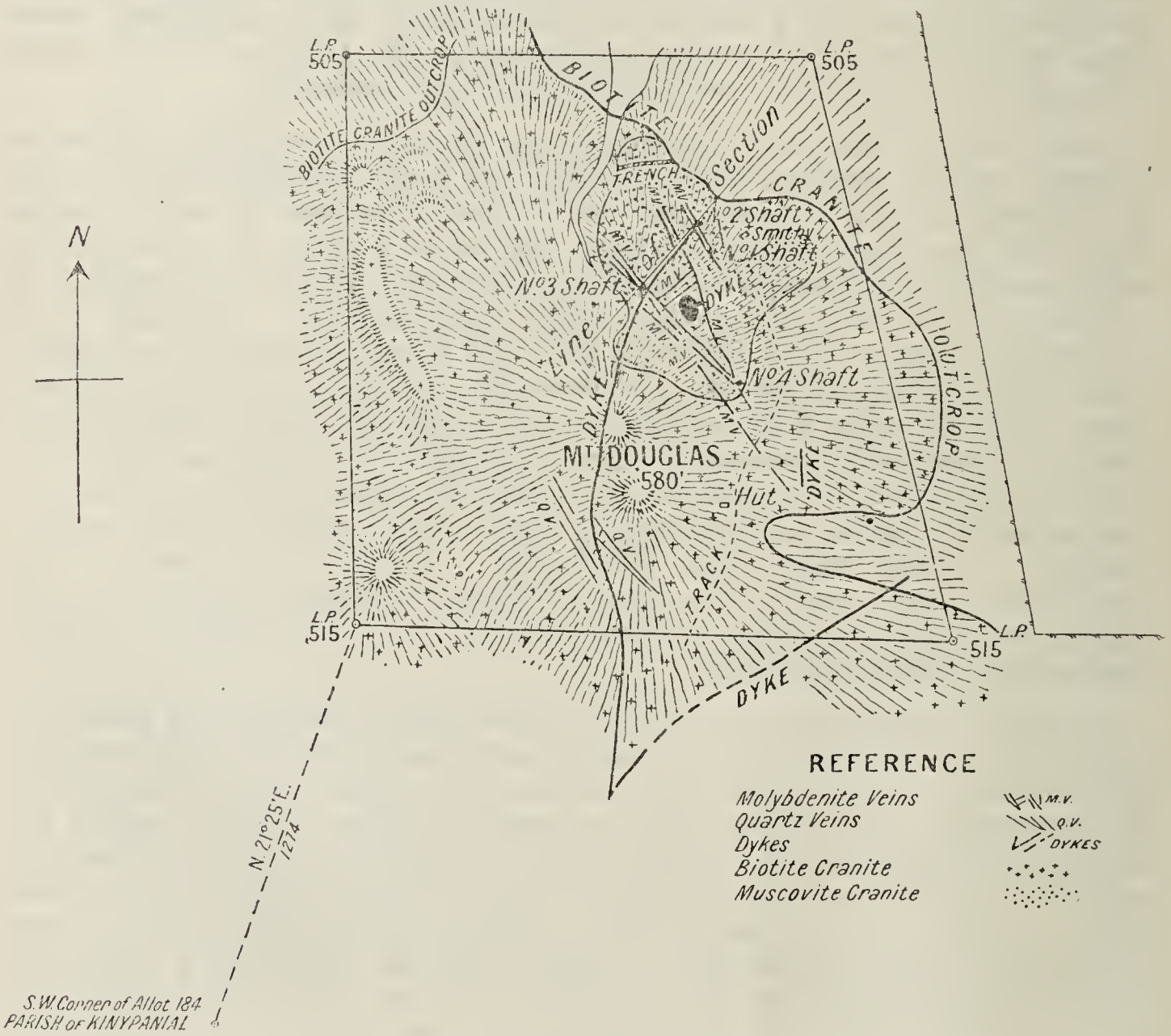


FIG. 124. Mount Douglas Molybdenite Mine, Korong Vale.
Scale: 8 chains to one inch. Height by Aneroid.

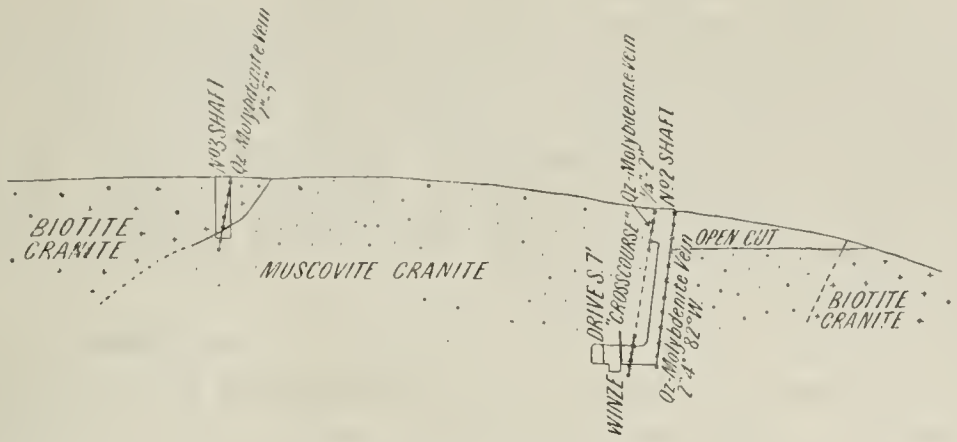


FIG. 125. Section.

Scale: 120 feet to 1 inch.

of the pipe-like outcrop of fine-grained sulphide-spattered material whose position in the muscovite granite area is delineated on lease plan. This plug, probably the youngest and most siliceous, is also the most highly mineralized of the members that go to the make-up of the Mount Douglas boss, and occupies a central position with regard to the molybdenite-bearing veins of the immediate locality. Surrounding this is an outcrop, roughly 3 acres in extent, of what, for purpose of distinction, is styled muscovite granite. It is variable in composition, passing by imperceptible gradations from fine through medium to coarse-grained rock. It is apparently the home of the molybdenite veins, those exposed showing a preference for the coarse-grained variety. Surrounding this again, and occupying the remainder of the lease is what is locally termed the biotite area. Though in places practically mica-less, it is generally a two-mica granite, the brown-coloured mica predominating. Like the muscovite rock it is variable in texture, and in the north-west and south-east corners, owing to a development of the felspar crystals, is somewhat porphyritic. Only at one spot, 2 chains east of "The Hut," has a molybdenite vein been uncovered in this area. Still further afield, bordering the other masses as an irregular fringe, generally outside the lease boundary and mostly covered by cemented grit, is a decomposed variety, whitish in appearance, and medium grained, which yields a fairly productive soil. Being highly felspathic and containing little mica, a sample was sent to the Geological Laboratory, but it was found to be valueless for pottery work.

Coursing through the high ground are a couple of fine-grained dykes. The one with a north-south strike in the southern half of the lease is, so far as is known, molybdenite-bearing only where it cuts through the muscovite granite. It is not looked upon as, or likely to be, an ore producer of value. Other narrower, more siliceous bands (acid excretions as distinct from intrusive dykes) cut through the biotite rock mass. Though of various strikes, the stronger show a general parallelism with the direction of the quartz veins than which they are older, the veins being the last to segregate from the mass. Of these (the molybdenite-bearing quartz veins, striking roughly between north-west and north-north-west) there are about half a dozen, all, with the exception of the westernmost (which has been traced southwards for 300 feet through the biotite mass) confined, so far as prospecting has revealed, to the muscovite granite area. Cross veins connect those lying between No. 2 and No. 3 shafts; it is to intersect the junction of these two systems south-westerly from No. 1 shaft (for position see plan) that the extension of the drive now in progress from No. 2 shaft has been

projected. The spot towards which operations are being directed constitutes in the structural complexity of the region a peculiar point, and with it as the objective, I recommend the furtherance of the work now in hand, upon the result of which will depend the future of the undertaking. As stated in previous report, the veins opened up are rich (26 cwt. 3 qr. 26 lb. treated at Parker's works, Footscray, contained 8 per cent. MoS_2), but their narrowness precludes the possibility of profitable extraction at present.

In both directions in the line of strike of the Mount Douglas veins the granite rocks are obscured by surface soil and Pliocene grits. Southwesterly, however, there are exposures, and in them dykes and quartz veins outcrop. A strip half a mile by 3 miles long lying between Mount Douglas and Little Mount in the parish of Korong was examined, in company with Mr. E. Wilkinson (the manager of Mount Douglas mine). A little prospecting has been done on half a dozen quartz outcrops in allotments 37, 37A, 53 and 55, the deepest hole being less than 10 feet. Molybdenite has been found in all and a little gold (4 gr. to ton) in two (those in allotments 37 and 37A), but, excepting the width of that in allotment 55, there is nothing impressive about any of them.

An inlier of altered sedimentaries on the Little Mount-road (referred to on the Wedderburn Quarter-Sheet as "brown micaceous rock, apparently highly metamorphosed Ordovician with angular quartz") seems to offer inducement for further prospecting. Molybdenite and gold in quartz have been found about the granite contact, but insufficient work has been done to prove the value of the deposits. A shaft has been sunk 9 feet at the northern end on a 6-in. quartz reef dipping 40° west and striking north 10° west. The further work that seems desirable here is not likely to be undertaken unless the Mount Douglas veins become producers.

[6.5.22.]

FLUORSPAR AT SANDY CREEK, NEAR WALWA.

By J. G. Easton.

This report deals with fluorspar lately discovered on the property of Mr. John O'Keefe, shown on the parish plan of Walwa as allotment 3, section XI., in the name of C. H. Hempel, jun., on Sandy Creek. The deposit is about $3\frac{1}{2}$ miles north-west of the Pine Mountain Creek Fluorspar Company's workings.

The mineral is associated with a quartz porphyry dyke which outcrops for about half a mile on a general strike of about N. 60° W. in a grey granite formation. The fluorspar so far as developed in a series of shallow surface cuts shows very promising prospects. Small surface costeans have been opened over a length of 8 chains, but the only exposure of fluorite worth comment at present is at the north end of these cuts, where a promising lode on the north-east wall of the dyke has been opened for a length of 90 feet, showing from 6 feet to 10 feet of fluorspar towards the north end, narrowing as it goes north. The cut does not exceed 4 feet in depth. This 10-ft. body of ore consists of

white and vitreous crystalline fluorite, with small veins and patches of the siliceous matrix intermixed, and so far no other minerals have been encountered in the lode. The dyke is continuous to the newer granitic intrusion of the Pine Mountain, which has caused considerable alteration to adjoining dykes. The formation is somewhat similar to the Pine Mountain Creek Company's lode, and as numerous similar dykes exist around the contact of the two granites, other fluor deposits may be discovered in this locality.

The limited amount of developmental work done is confined to Grant's lease, No. 3737.

Two samples from this locality were examined in the Geological Survey laboratory, and found to contain 43 per cent. and 67.5 per cent. of calcium fluoride respectively.

[4.12.20]

WAVELLITE NEAR PEECHELBA.

By J. C. Grieve.

The 160 acres applied for under lease by Mr. Francis is situated about 40 chains south-west of Griffin's homestead. It is located partly on Crown lands reserved as a State forest, and partly on an area selected by W. Berthun (allotment 72, parish of Kilawarra), and which, I am informed, has reverted to the Crown.

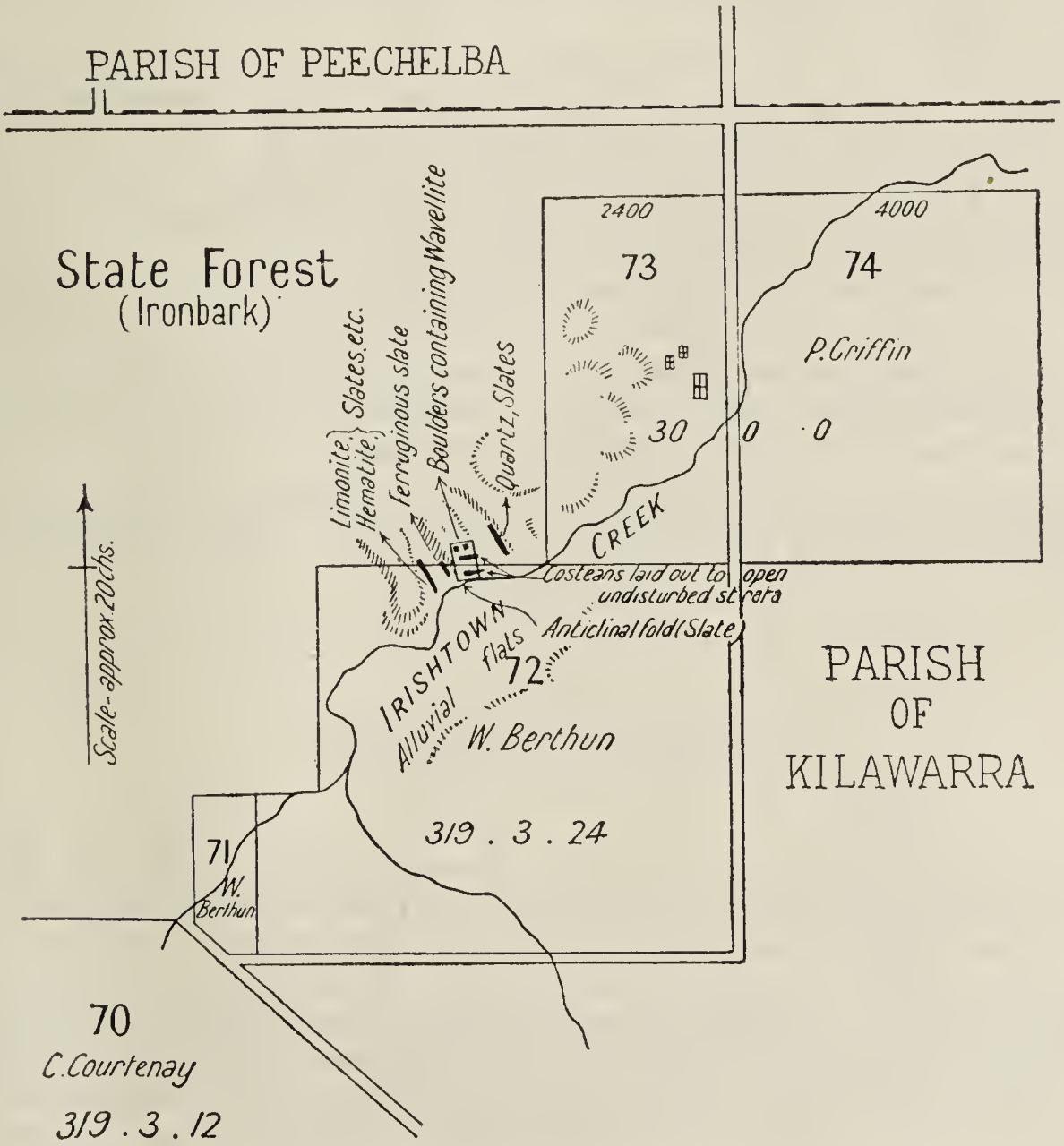


FIG. 126. Locality plan.

The surface of the lease is made up of low hills or ridges rising to about 100 feet above the level of local drainage system and, to a lesser extent, of apparently shallow flats along Irishtown Creek.

The strata are probably of Upper Ordovician age, and consist of bleached slates, fine sandstones, and quartzites. There has apparently been considerable secondary silification, and in places the surface deposit on the hills is largely composed of eroded fragments of narrow seams of a dark greyish quartz. These fragments, with larger detached rocks and a soil of poor agricultural value, overlie the undisturbed rocks, and so I was only able to make an approximation of the country rock strike as north-west.

Near the centre of the lease there is on the crest of a low ridge, bearing about N. 60° W., an area of about 40 feet wide and 150 feet in length (along the ridge) where, from the surface deposit, boulders—detached, but probably nearly *in situ*—outcrop. Some of these boulders range in size up to 24 inches x 18 inches x 15 inches, and contain a network of veins, varying up to $\frac{1}{2}$ inch thick, of the mineral wavellite.

At this locality the prospectors have sunk two holes to a depth of nearly 3 feet, and cut an even shallower trench about 20 feet in length. These excavations were too shallow to expose a section of the undisturbed strata or the location of the channel or source of the phosphate minerals.

I laid out the position of two transverse costeans, which will attain a depth of about 6 or 7 feet; these trenches will be about 60 feet apart, and when completed will probably give definite details of the mineral lode and adjacent strata.

Adjacent to the west of the mineral area the rocks contain probably 10 per cent. to 15 per cent. of Fe_2O_3, whilst 250 feet further west there is an outcrop of fairly pure limonite and hematite.

To the south, about 30 feet in the creek bank, the arch of a small anticlinal fold in the slates just appears above water level.

The mineral wavellite on or near exposed surfaces is of a very light colour, but deeper in the rocks the characteristic green tints are evident.

A preliminary expenditure of £25 in locating the source of the mineral is warranted from evidence available of the size of detached blocks and their richness in phosphate of alumina.

Since my visit I was informed by a district settler that he had found this mineral, but of a pale colour, about 4 miles to the north-west.

[10.10.22.]

LIGNITE AT BEENAK.

By R. A. Keble.

An outcrop of lignite occurs in allotment 68c, parish of Beenak, about 6½ miles from either Yarra Junction or Launching Place, and from 3 to 4 miles from the timber tram from the first-named township.

In a cut about 6 feet wide at the foot of the basaltic lava residual on the north side of Hoddle's Creek, a bed of dark lignite, about 3 feet wide, resting on fluvatile clays, has been exposed over the width of the cut. Owing to the curvature of the bed, which has doubtless been influenced by the profile of the old valley in which it was deposited, it

was impossible, with the small amount of work done, to define accurately its lateral extent. It would appear, however, that the cut has been

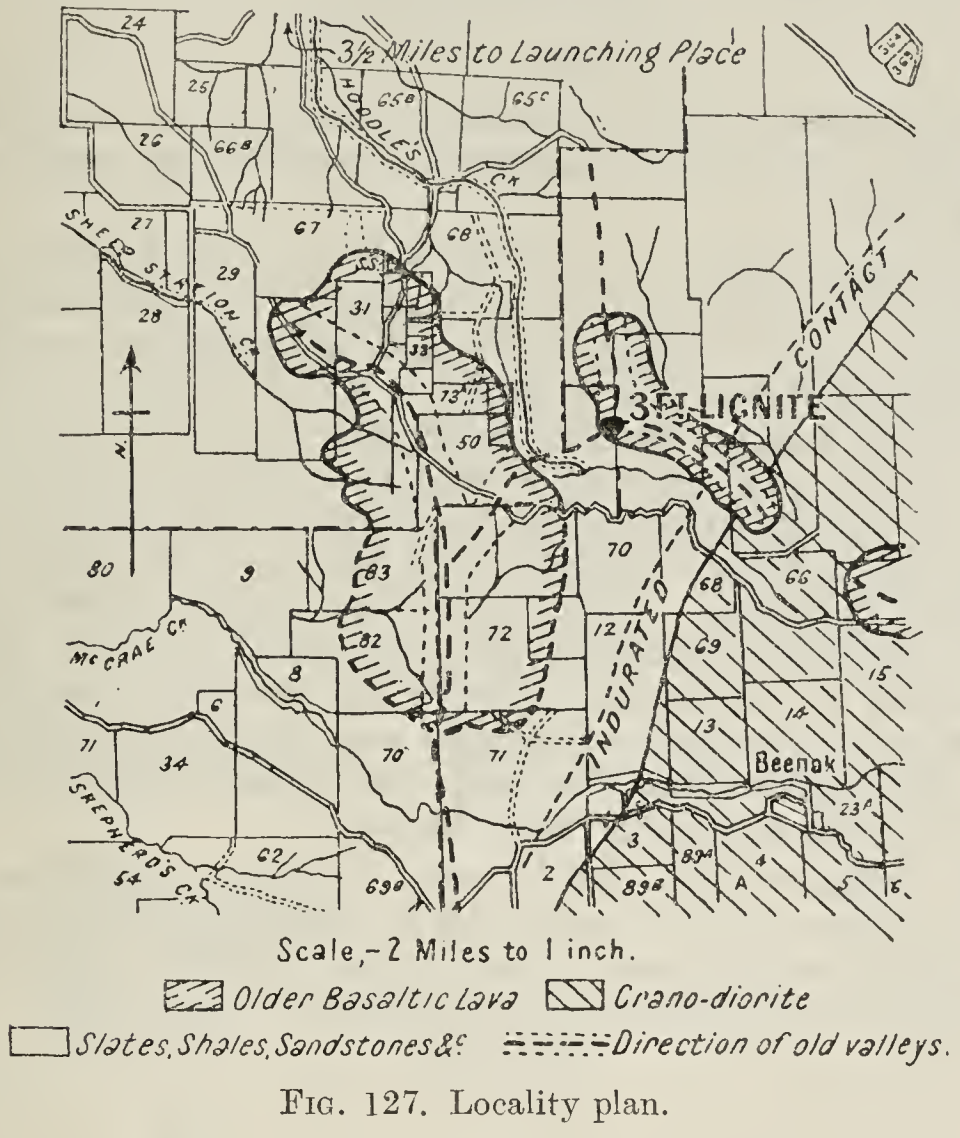


Fig. 127. Locality plan.

made at or near its eastern fringe, and that the greatest width and thickness will be found in a direction approximately N. 30° W. from the cut. The longitudinal axis of the deposit will, therefore, be approximately N. 30° E., and the bed will extend into the hill on the north side of the creek and below the lava residual.

The bed is not continuous throughout the exposure, but is interrupted by pockets of clay, and faulted. A spring comes from the exposure, and trickles into Hoddle's Creek. The overlying beds for a few feet to the north consist of quartz grit and volcanic loam—a surface wash from contiguous deposits, resting on decomposed basalt.

The lignite is dark with a high percentage of water, and disintegrates on exposure to the air. On splitting it along the laminæ, the imprint of leaves (Eucalyptus and Lomatia?) and fossil fruit indicate that it is similar to that obtained at Berwick, and is of the same age. A proximate analysis was made at the Geological Survey laboratory.

Proximate Analysis (No. 728).

H_2O	45.94%
V.H.C.	25.22%
F.C.	22.16%
Ash	6.68%
Total	100%

The lignite would not be of commercial value, as it is of insufficient thickness and extent; the country in which it occurs is rather inaccessible; and mining operations on the seam are likely to be costly.

[21.6.19.]

COAL AT MOSQUITO CREEK, NEAR TRAFALGAR, SOUTH GIPPSLAND.

By Stanley Hunter.

Reginald Murray in 1878 reported on this coal seam, but, owing to insufficient data, he could not determine whether the coal was Jurassic or Tertiary in age.

It has now been driven on for over 100 feet, and I think there is no doubt that it is a Jurassic seam, a portion of which has been exposed as a land surface in later Tertiary times, and subsequently covered by grey and red mottled sandy clays and basalt. The tunnel has cut through a definite section of a small filled-in gully, the west side of which appears to consist of decomposed sandstone, and the east the originally exposed coal seam. It is possible that on driving further into the hill the Jurassic strata may be found over the coal, and that the coal may improve in quality and in thickness. At present from 12 inches to 14 inches of extractable coal can be obtained; this may be of value if worked by a private syndicate or co-operative party, but would be unpayable for a company. Seams of a similar thickness were worked some 20 years ago at Coalville, and by the Moe Company, the latter workings being about $2\frac{1}{2}$ miles east of the Mosquito Creek tunnel.

The seam has generally a level course north and south and a dip of 1 in 9 in the tunnel to the west, and I recommend that when a drill from Morwell is available one or two bores be sunk to the east of the tunnel to test the continuation and thickness of the seam.

[9.8.22.]

THE KILMORE OIL COMPANY.

By W. Baragwanath.

In the Kilmore *Advertiser* of 11th February, 1922, an article dealing with "Kilmore Oil-fields" states:—"The challenge issued by the 'experts' of the State Mining Department to produce a thimbleful of oil is scouted. The Minister of Mines himself, if he paid a visit to the Kilmore field, could take away a bottleful."

In company with several interested investors, I paid a visit to Kilmore, and inspected the site of boring operations, and have no hesitation in saying that there is neither now, nor ever was, nor ever will be, any oil produced from boring in this locality.

The area consists of a volcanic flow cut into by several streams which show in their channels either bedrock (Silurian) or basalt and clays, forming narrow strips overlying shallow leads. In the portion where a lead occurs, the bores are located. An area of about an acre is affected by landslips, due to the water reaching underlying clays, and the pressure of the slipping overburden has caused the ligneous clays to crumple. This feature is ascribed by some interested parties to mud volcanoes, and is erroneously regarded by them as due to gas or oil pressure. A small flow of water is coming from the bore holes; this, considering that the bores are near creek level, and that the surrounding hills rise to over 100 feet above that level, is not a unique phenomenon.

[17.3.22.]

SUPPOSED BITUMEN AT WARATAH BAY.

By W. Baragwanath.

In company with Mr. A. R. Dowling, I visited Waratah Bay to inspect the site of an alleged deposit of bitumen, and to determine its possible relation or otherwise to petroliferous formations at a depth.

The deposit is situated at high-water mark on the sea shore about 5 chains south-east of the Lime Company's jetty, and at the foot of a steep bank of highly metamorphosed strata, both siliceous and calcareous. I was informed that soft black material with a conchoidal fracture was obtained from a shaft now filled with sand. At the surface this material occurred in a small circular pipe, which widened at a depth of a few feet, sending out ramifications into the containing strata, and the prospector was justified in thinking the deposit was enlarging in depth, and consequently getting towards the source. The black material, however, instead of being bitumen, is a brown coal which filled the crevices from the surface, and has subsequently undergone chemical change until it attains the present lustrous character. Similar material, associated with lignite and brown coal occupying larger faults and fissures, is noticeable between high and low-water mark further north, so the origin of the material is undoubted.

An analysis of sample at the Geological Laboratory gave:—

	Per cent.
Water	53.6
Volatile matter	17.2
Fixed carbon	8.90
Ash	20.30
Bitumen	.04
Total	100.04

[9.6.22.]

SUPPOSED PETROLIFEROUS GAS AT CHARLTON.

By H. S. Whitelaw.

Robinson's dam is the site of some recent experiments carried out by Mr. Ryan and some dozen other residents, and is the spot, I am told, where the inflammability of the gas was first publicly demonstrated. It lies between the Swan Hill road and Klunder's Hill, about $1\frac{1}{2}$ miles north of Charlton. The bedrock of the district is Ordovician. The Klunder's Hill beds dip westerly; those of the Barrakee Hills, 3 miles away, dip easterly. Between the two ranges the Avoca River has apparently cut its way along an anticline with a strike of a few degrees west of north. It is from the surface of the recent rocks of the river valley that gas can be tapped, and then only by disturbing the mud forming the bed of the dams and river. So far as I could learn, no natural gas has been found in the flanking bedrock, which is composed of sandstones and interbedded thin seams of shale, some of the latter being carbonaceous. It is to these beds that those interested look for the supply of petroleum, the supposition being that in the folded rocks underlying the valley there exists an oil reservoir from which has emanated the gas now found imprisoned in the dam mud, which prevents its escape at the surface. This view, though not wholly untenable, is discountenanced by the data in my possession. The outcropping standstones, for instance, are silicified to a degree of density that could hardly permit of the conservation of oil; the gas is inodorous, and further, the so-called

oil film (that portion I was able to collect from the sheltered pools in the river channel) is a bi-carbonate of iron deposit. The weight of evidence is in favour of the conception that the gas is the outcome of the decomposition of vegetable matter in the damp upper layers of the alluvial deposits—that is, that it is purely superficial, not of deep-seated origin.

However, there being no doubt as to the presence of the gas, but some as to its origin, the Charlton Valley Oil Syndicate is taking the right steps to determine the point at issue. Its intention is, when it becomes a properly constituted company, to enter on a well-devised scheme of deep boring.

Addendum.—The bores put down by the company failed to show any indications of mineral oil, and work has ceased.

[16.4.21.]

THE CHARLTON OIL COMPANY'S AREA, CHARLTON.

By Stanley Hunter.

The general formations of the area recently bored for oil by the Charlton Oil Company consist of granite, slightly altered slates and sandstones (probably Ordovician), and widespread but thin Tertiary flats. Within the last-named are small local areas containing magnesite and quartzite.

Four bores have been sunk as follows:—

No. 1.—Clifton Hill, lying on the north side of the town; sunk to 103 feet wholly in Ordovician.

No. 2.—On the Charlton P.R., about 2 miles northward from Charlton; sunk to 85 feet, and still in gravel and sand of Tertiary age when boring ceased.

No. 3.—In allotment 9B, parish of Wooronook, about 3 miles west of Charlton. Sunk to 185 feet. From the appearance of the dried sludge now on the surface, and obtained from the bottom of the bore-hole, I think the bore passed through the Tertiary covering and entered the Ordovician bedrock.

No. 4.—In allotment 27, parish of Charlton West, and about 2½ miles north-westward from Charlton. This was sunk wholly in Ordovician.

The Ordovician strata here have a pronounced westerly dip, and in places they are almost vertical. It is quite useless to hope for oil in these strata.

The overlying Tertiary strata have not sufficient thickness to warrant any hope of locating oil.

I regret being unable to give a favorable opinion on this district, as I recognize that a bona fide attempt has been made to prospect for oil, but under the geological conditions existing in the district I regard it as useless to bore further.

[16.3.22.]

GAS VENT NEAR CAMPBELLTOWN.

By D. J. Mahony, M.Sc., F.G.S.

In a small water reserve in allotment 48B, parish of Campbelltown, about half way between Franklinford and Campbelltown, is a gas vent

from which a considerable volume of gas constantly escapes. It has been known for many years, and is marked by a shallow hole sunk by some prospector. When inspected, the hole was full of water, which was kept in constant agitation by the escape of gas, so that it had the appearance of boiling. In the summer the water dries up, according to local residents, but the flow of gas continues. The ground is obscured by soil and grass, but some of the spoil from the hole can be seen, and this evidently consists of Ordovician slate traversed by quartz veins. Within a short distance are surface outcrops of Ordovician beds striking in a northerly direction, and having a steep dip. A faint mineral smell similar to that at the Hepburn spring can be noticed.

The vent is situated on a slope extending westerly from a basalt-covered ridge to the valley of a creek.

A sample of the gas analyzed in the Geological Survey laboratory contained 99.3 per cent. of carbon dioxide—the same gas which is found in the effervescing springs of the Daylesford district. If the vent were in a more accessible locality it might be suitable for the manufacture of aerated water, but it is not likely to have any other commercial value. It has no relationship to the inflammable gases that sometimes indicate the presence of mineral oil below the surface.

[15.8.21.]

TERTIARY MAGNESIAN-LIMESTONE AT COIMADAI.

By R. A. Keble.

The magnesian-limestone in allot. 14A, sec. XXII., Parish of Merrimu, is the extension of that quarried by Alkemade Brothers on the south side and by E. Burnip on the north side of the Toolern-Bacchus Marsh-road. It is the remnant of a freshwater lacustrine deposit of post-Newer Basalt age resting on the sides of the valley of the Coimadai

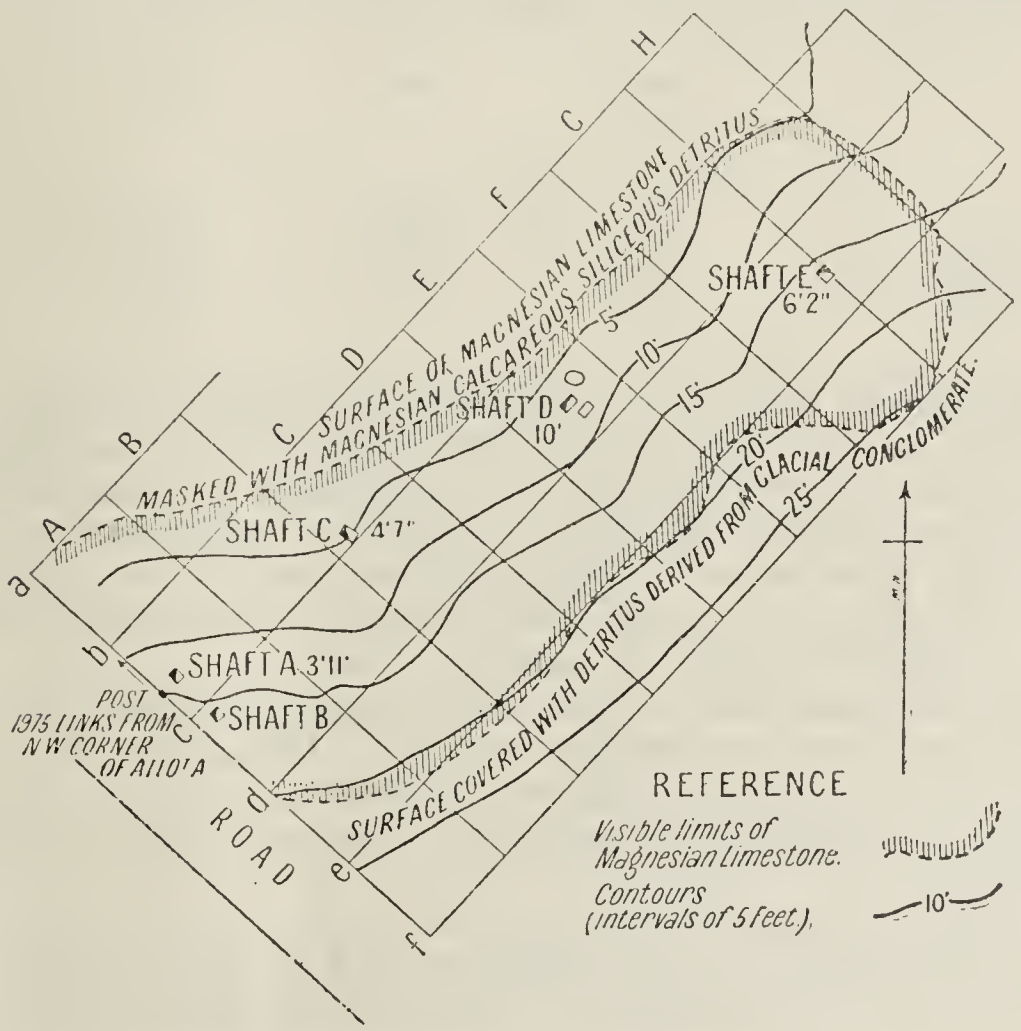


FIG. 128. Plan. Scale: 3 chains to 1 inch.

Creek, but formerly occupying the whole valley when the creek flowed at a higher level. A cessation of the flow of the creek, caused by the Mount Bulleugarook lava flows damming it at a point somewhere south of Coimadai township and converting the valley as far as Coimadai into a freshwater lake, is the direct cause of the deposit in this vicinity.

The thermal mineralized springs—one of which is still flowing near the limestone and which contains a high percentage of magnesium and calcium salts—the concluding phase of vulcanism—supplied the lake waters with their magnesian and calcareous "load." The deposit is stratified and to outward appearances has been subject to movement resulting in gentle folds; I am inclined to think, however, that the stratification is due to chemical precipitation.

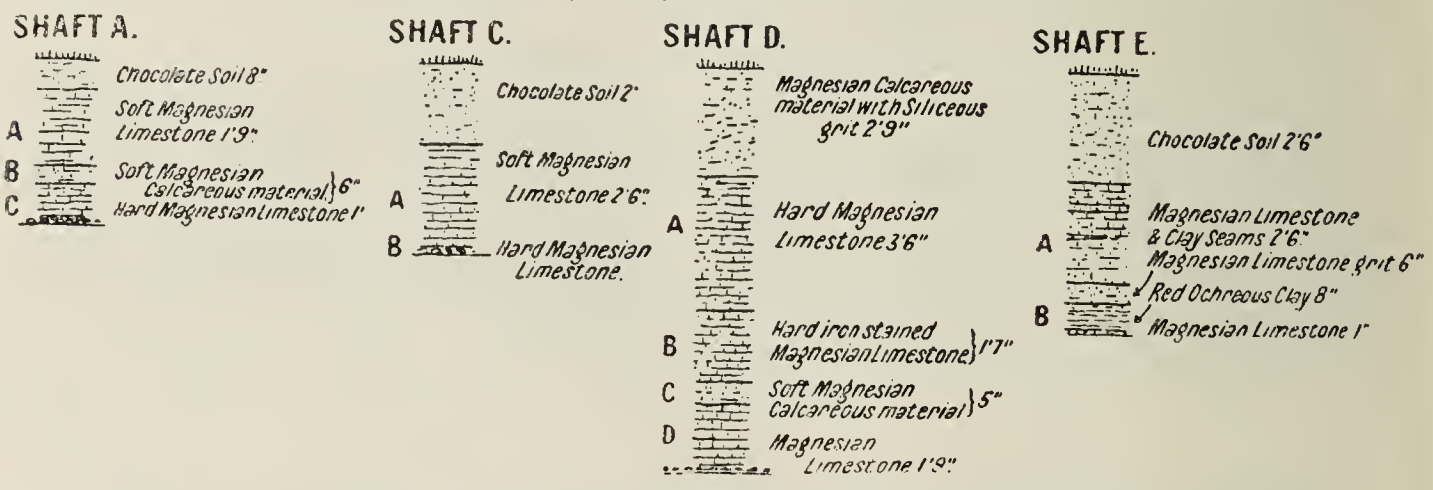


Fig. 129. Sections of shafts marked on plan.

Samples of several pounds weight were taken from several shallow shafts put down in the magnesian-limestone. Each stratum was sampled and a weight proportional to the thickness of the several strata exposed in each was taken and well mixed. The composite samples thus obtained were analyzed by Mr. F. F. Field, at the Geological Survey Laboratory (No. 1293-1297/19) and gave the following percentages for the average magnesian-limestone exposed in each shaft.

——	Shaft A.	Shaft C.	Shaft D.	Shaft E.
	%	%	%	%
Insoluble matter ..	32·27	48·01	14·70	43·80
Calcium carbonate ..	26·64	19·27	42·56	18·62
Magnesium carbonate ..	21·88	14·52	33·68	17·80

To maintain an even grade magnesian-limestone averaging 26.77 per cent. of calcium carbonate and 21.97 per cent. of magnesium carbonate, the highest percentage attainable if it is desired to maintain a uniform percentage and utilize the whole deposit advantageously, it will be found that it is necessary to take approximately four loads from the vicinity of Shaft A, six loads from Shaft C, three loads from Shaft D, and six loads from Shaft E, and mix them.

The specific gravity of a composite sample obtained by mixing all samples in their due proportions is 2.54. Using this as a factor for estimating the quantity of magnesian-limestone exposed in the shafts, I estimate on a conservative basis that there is at least 50,000 tons to be quarried.

The deposit is advantageously situated for quarrying. It is improbable that its extension to the north-west and south-east is much beyond the limits shown; the deposit in that direction has probably been de-

nuded by creek entrenchments. In short, the deposit may be considered a terrace resting on the sides of the valley, and is probably limited in its lateral extent.

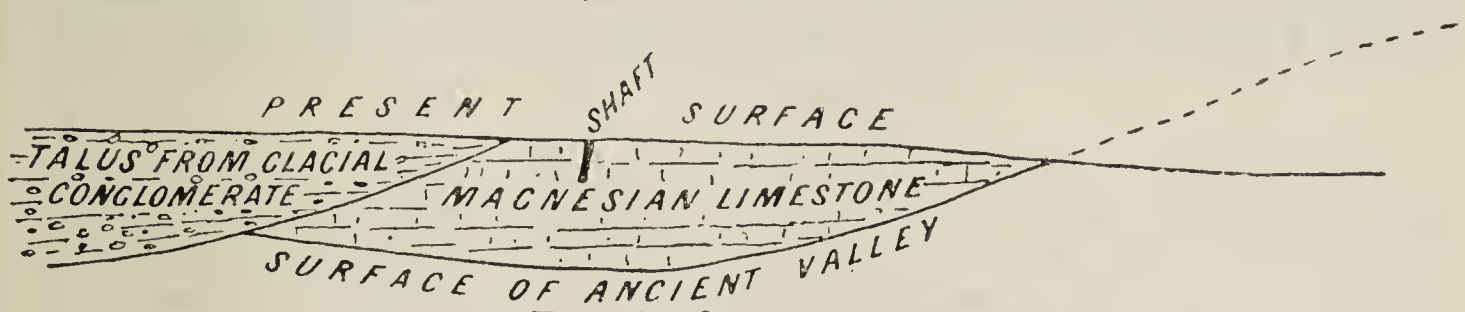


Fig. 130. Sketch section.

There are indications, however, that magnesian-limestone occurs to the north-east.

With regard to quality, it should be noted that samples analyzed some years ago from quarries then at work in this locality, contained over 94 per cent. of calcium and magnesium carbonates, and under 6 per cent. of insoluble matter, which indicates much better material than that described in this report.

[20.2.20.]

SILURIAN LIMESTONE AT MARBLE CREEK, THOMSON RIVER.

By A. E. Kitson, F.G.S.

The limestone or marble occurs on the southern side of Marble Creek, a tributary of the Thomson River, about 12 miles west-north-west of Toongabbie. There are two outcrops of the rock, one about a quarter of a mile above the junction of Marble Creek with the Thomson River; the other outcrop about half a mile more southwards. These

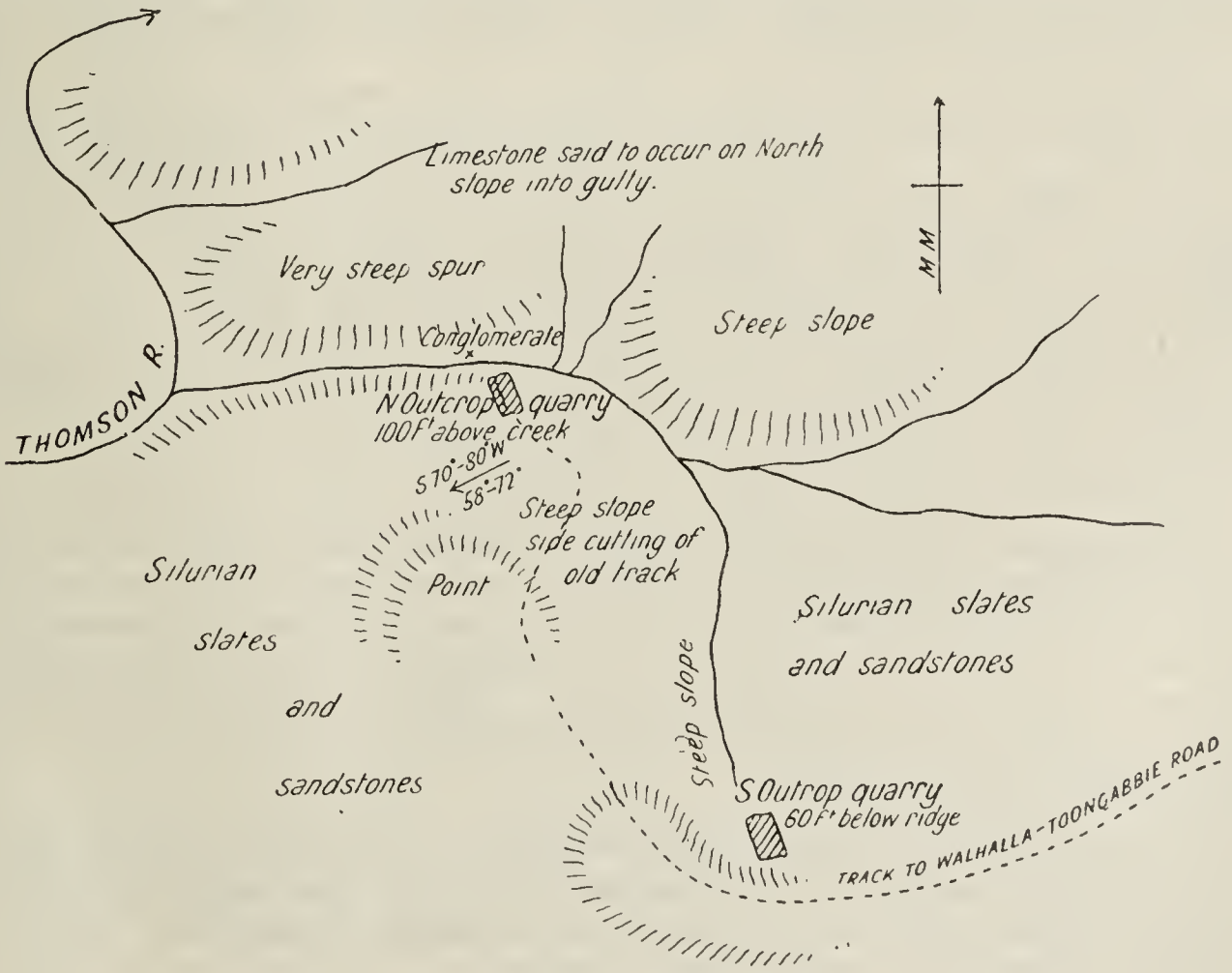


Fig. 131. Locality plan.

outcrops are not apparently portion of a continuous bed of limestone as far as the evidence in the field indicates, but rather appear to be remnants of a once more-or-less continuous bed, or to be separate lenticular patches. They occur in strata consisting of very fissile slates, having a general northerly strike and a dip to west at high angles.

Northern Outcrop.

At this place a small quarry was opened many years ago when some of the stone was taken out and carted in bullock waggons to Toongabbie. The quarry shows the marble to be 42 feet wide and 60 feet long receding into the steep face of the hill, where the workings show it to be 15 feet high. It doubtless continues in depth, but to what depth can only be ascertained by further work.

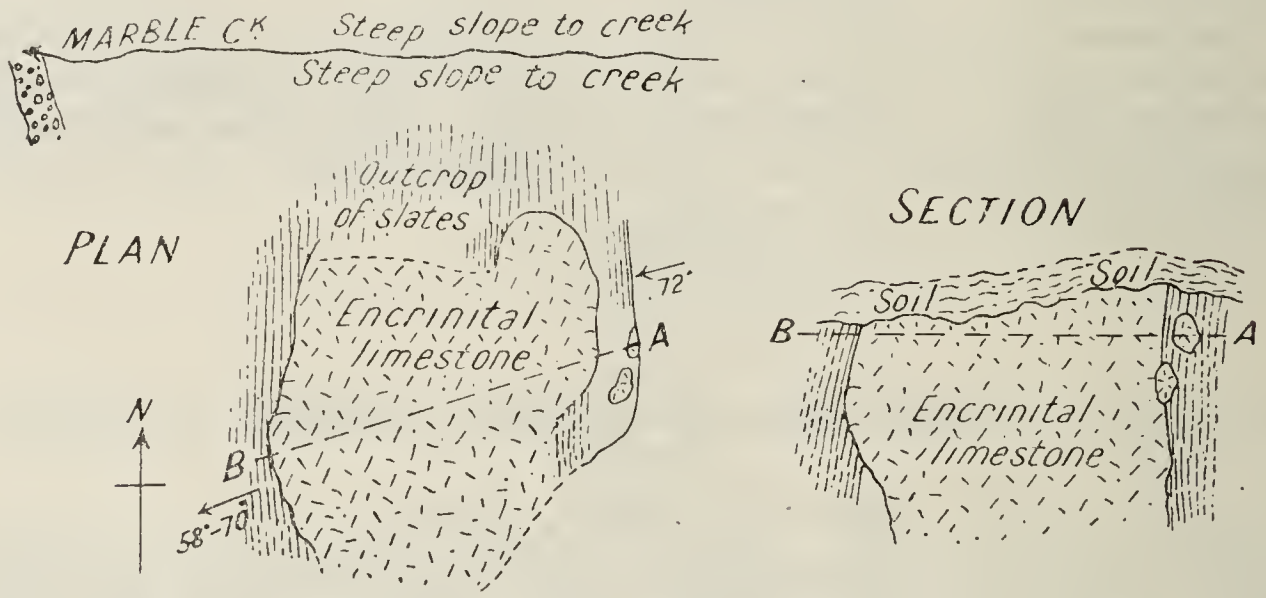


Fig. 132. Plan and section of Northern Outcrop.

The marble lies between fissile slates, as thin as sheets of paper in parts, and of a bluish-grey colour. These slates strike north 10° to 20° west, and dip westerly at from 58° to 72°. The marble is not evenly bedded with the slates, but has a very irregular margin, both on the upper and lower side and at the north end, the only end visible.

In the body of the quarry there are large blocks of good encrinital marble separated by joint planes which are filled with red soil. These blocks of marble are crowded uniformly with encrinites, which on weathering stand out clearly from the main mass of the rock. The marble is sound, of bluish-grey colour and very suitable for ornamental purposes, where blocks of no great size are needed. With increased depth there will be less soil, and larger slabs will be obtainable.

The marble does not appear in the creek, which is 100 feet below the opening into the quarry and about 2 chains north of it; neither does it appear immediately opposite on the slope of the hill. In southerly extension along the strike of the beds it may continue for several hundred yards or may end abruptly as it apparently does at the north end Further work above, either by trenches, shafts or bores on the side of the hill, is needed to prove this, as at present the débris from the slates on the steep hill covers it.

This outcrop is 330 feet below the point of the spur, which here is very steep, while it is 430 feet below the top of the ridge, half a mile away, to which access is easy from the Walhalla-Toongabbie road. It is distant from this road about 2 miles.

Southern Outcrop.

The southern outcrop lies about 30 chains from the northern outcrop, and is about $1\frac{1}{2}$ miles from the Walhalla-Toongabbie-road. It is on the fall into Marble Creek, about 60 feet below the top of the ridge leading to the Walhalla-road, and about 370 feet higher than the northern outcrop.

Fig. 133. Section across Southern Outcrop.

A small quarry has been opened here, but the rock has not been exposed as well as that in the northern quarry.

The full width of marble exposed is 36 feet, but an additional 6 feet on the western side is decomposed limestone converted into calcareous ironstone. A chemical analysis is given at end of this report. The 36 feet of marble consists of two kinds—20 feet on the east side is a dense dark bluish-grey rock of medium texture, with a few small encrinites, and 16 feet on the west side is also dense, but light grey in colour. Larger blocks could probably be quarried here than at the other quarry since the rock is denser and apparently less decomposed along the joint planes, though patches of soil occur in the rock. The marble extends into the ridge and is exposed for a length of about 50 feet. It lies between yellow slates similar to those in the northern outcrop. These slates strike about north 10° east, and dip steeply to the west.

The limestone extends northwards about 50 feet up the hill, but becomes narrower. Its actual length is uncertain.

The marble is capable of taking a good polish when the contained fossils show clearly against the bluish-grey of the stone. I have no hesitation in saying that the material is valuable for decorative uses if the deposits are sufficiently extensive and the stone can be quarried and sent to Melbourne at a reasonable price. Thorough prospecting is necessary before available quantities can be estimated. It is a matter of doubt how far each of the outcrops described extends in a southerly direction, and how far the southern outcrop extends in a northerly direction. I think that they are separate lenticles, but they may prove to be of sufficient thickness to supply large quantities of stone. The rock is suitable for lime burning if economic conditions should warrant the industry in this locality.

From a scientific point of view the occurrences are of interest. The marble appears to be interstratified with Silurian slates similar in age to the crystalline limestones of Lilydale and Waratah Bay, but instead of thinning along the strike in both directions, as lenticles usually do, the only visible section shows the limestone ending abruptly against thin slates. At the northern quarry there is evidence of faulting in the form of two quartz veins with striated faces. The faces of the

quartz show parallel striations which in the two veins differ in direction by about 45°. A little to the north-east of the northern deposit is a bed of conglomerate consisting largely of pebbles similiar to the indurated Silurian rocks, and in it was found a piece of the encrinital limestone about 14 inches long and 8 inches broad.

Lenticular patches of limestone are characteristic of the Silurian strata in the Thomson River district. Some miles to the north of the northern outcrop herein referred to, and in the direction of its strike there is a lenticular mass of similar encrinital marble on Deep Creek, while, some 5 miles to the west, this belt of strata containing limestones is repeated by the folding of the strata along a generally north and south line, and crystalline limestone occurs near the copper mine, Thomson River, and extends northwards in a series of disconnected lenticles up the valley of the Thomson to Aberfeldy.

——	A.	B.	C.
	%	%	%
Insoluble (SiO_2)	0·75	0·72	2·82
Alumina (Al_2O_3)	0·35	0·16	5·49
Iron oxide (Fe_2O_3)	0·40	0·26	61·00
Lime (CaO)	(54·30)	(54·68)	(11·51)
= $CaCO_3$ (Carbonate of lime) ..	97·12	97·64	20·55
Magnesia (MgO)	(0·78)	(0·53)	(1·30)
= $MgCO_3$ (Carbonate of magnesia) ..	1·63	1·11	2·73
Water at 110° C.	0·08	0·05	..
120° C.	..	..	2·88
150° C.	..	..	0·51
	100·33	99·94	95·98

Analyst—P. G. W. Bayly.

A. Limestone, northern outcrop. No. 445/05.
B. Limestone, southern outcrop. No. 448/05.
C. Calcareous limonite, southern outcrop. No. 449/05.

[16.12.05.]

SILURIAN LIMESTONE, TYERS RIVER, GIPPSLAND.

By O. A. L. Whitelaw.

The formation is situated on the Tyers River, an affluent of the Latrobe River, between the parishes of Boola Boola and Tanjil East, at about 10 miles by road north-west from the township of Traralgon, and 3 miles above the alluvial flats formed by the Tyers and Latrobe Rivers. Its position is accurately shown upon the geological survey of the parishes of Boola Boola and Tanjil East.

The deposit or bed is of Silurian (? Yeringian) age, and is interbedded below shaly slates and on calcareous and flint conglomerates containing a considerable amount of interbedded volcanic matter. It can be traced along the bed and banks of the Tyers River for a distance of about 70 chains, and in places reaches a width of 100 feet.

The deposit is not continuous in length, but consists of a series of lenses thinning out north and south, and again increasing in width. The strike of the beds is nearly due north and south, and the dip about 60° to the west.

A large portion of the deposit is in the bed of the river, but in numerous places forms small cliffs abutting upon the water's edge and rising to 15 or 20 feet in height. In two instances, where the slope of the hill coincides with the strike and dip of the beds, it can be seen at a height of about 100 feet. The limestone is of blue, crystalline, and very pure, and in places has been converted to a dark grey or nearly black marble, suitable for a building stone.

There is no doubt a valuable deposit of lime exists here, but situated as it is in a gorge or canyon of the river with banks nearly vertical to upwards of 500 feet, the difficulty of transport is considerable. A tram line of about 10 miles in length would have to be constructed to the nearest rail point, and this track should be so graded that steam or electric power could be used for the transportation of the material.

The Traralgon Shire Council obtains its water supply for the town from the Tyers River, about 2 miles above the limestone outcrops.

[30.6.20.]

TRAVERTINE LIMESTONE AT MOUNT BEST, NEAR TOORA.

By W. Ferguson.

The site of the limestone is on the holding of P. Fink, parish of Woorarra, about half a mile to the south of the Mount Best State School. In the allotment there is a fault which appears to trend in a north-easterly to south-westerly direction across several spurs and gullies. Evidence of land-slips can be seen, and the rocks appear to have slipped along the fault towards the gullies on the east.

In one place a mass of rubble and impure limestone in the form of travertine rests on the Jurassic sandstone and shale beds, and here in the rubble a small cave occurs with stalactites on the roof and stalagmite on the floor. There is a fair amount of travertine limestone about this place. Water flows along the fault and issues as springs which deposit more or less limestone and iron oxide. In one gully, water, under pressure, issues from the Jurassic rock, and a small jet spurts from the rock for a height of 6 inches.

If a large amount of travertine were available it would be useful for agricultural purposes, and possibly for building, but the quantity, apparently, is small.

Similar occurrences are not common in Gippsland. I inspected one at the falls at the junction of the Victoria Creek with the Albert River, at Madalya; and another on the allotment of P. Cantwell, parish of Binginwarri.

In each of these occurrences, I consider the limestone is due to water moving along the faults which somewhere intersect a bed of calcareous sandstone. This rock may contain but a small percentage of lime which acidulated waters dissolve and carry in solution until the fault reaches the surface where lime is then deposited as more or less pure travertine.

[4.7.19.]

TERTIARY LIMESTONE AT STONY CREEK, NOWA NOWA.

By A. M. Howitt.

In allotment 2, sec. II, parish of Colquhoun East, and about 4½ miles south-west of the Nowa Nowa Railway Station, there is a large area of Tertiary limestone. This limestone is mostly a soft yellow to grey rock with some hard beds charged with marine fossils, the larger types of which form distinct bands. From a rapid inspection of the fossils, Mr. F. Chapman considers it to be Miocene in age.

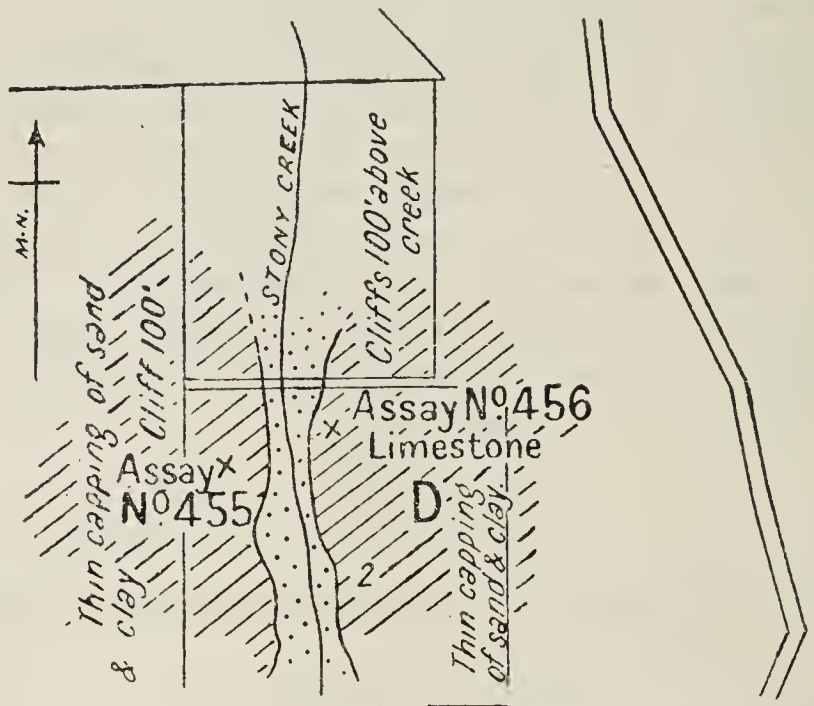


FIG. 134. Plan. Scale: 40 chains to 1 inch.
Miocene limestone hachured; alluvial sand, &c., dotted.

On both sides of Stony Creek prominent cliffs of limestone rise to about 100 feet. The limestone on the east side of the creek is exposed for 20 feet to 30 feet in places, and the occurrence of floaters down the soil-covered hill slope gives evidence of the underlying limestone. A partial analysis made at the Geological Survey laboratory of a sample from near the top of the cliff gave:—

No. 456.—$CaCO_3$ ... 86.56 per cent.
P_2O_5 ... trace.

On the west side of the creek a 20-ft. cliff was sampled over 10 feet in one exposure, the analysis showing a nearly similar result to No. 456.

No. 455.—$CaCO_3$ ... 86.9 per cent.
P_2O_5 ... trace.

Here, also, there is evidence of limestone beneath the cliff exposure. In an adjacent gully some chains west of the Stony Creek cliffs there is another prominent limestone cliff.

The whole limestone formation is, with the exception of the cliff exposures, masked by a thin capping of sand and clay, but, although the examination was somewhat cursory, sufficient was seen to demonstrate that an immense quantity of limestone occurs on Stony Creek.

CEMENT TESTS WITH MATERIALS FROM NOWA NOWA

By J. C. Watson.

The samples tested consist of soft Tertiary fossiliferous limestone (No. 910) and grey Ordovician slate from the railway cutting near Nowa Nowa station (No. 909). The samples were sent in by the Hon. James Cameron, M.P.

ANALYSIS OF RAW MATERIALS.

—	909 (Slate).	910 (Limestone).
	%	%
SiO_2	71·22	3·30
Al_2O_3	14·38	2·55
Fe_2O_3	3·63	4·14
MgO	1·52	0·74
CaO	0·56	48·00
Na_2O	2·26	..
K_2O	2·23	..
H_2O — (105° C.)	0·80	0·80
H_2O + (above 105° C.)	2·72	40·08
CO_2	Nil	
TiO_2	0·28	..
P_2O_5	..	Trace
SO_3	0·26	Nil
Cl	Trace	Nil
Total	99·86	99·61
$MgCO_3$	..	1·55
$CaCO_3$	..	85·71
Analyst	F. F. Field, Geol. Surv. Lab.	F. Moss, Geol. Surv. Lab.

The finely crushed raw materials were proportioned by calculation, and a batch of the meal was made in the following ratio:—

The meal was made into a stiff paste with water, cut into $\frac{1}{2}$-inch cubes, and allowed to dry for several days. It was burnt in a specially constructed shaft kiln and allowed to cool down overnight. The clinker was sorted into three grades—(*a*) underburnt, (*b*) overburnt, (*c*) good burn. It was necessary to make several experimental burnings to gauge the temperature required to produce the right grade of clinker. The fuel used was coke. After crushing the clinker 2% of gypsum was added to the cement to slow the set. The cement was submitted to standard specification tests and analysis; the physical tests were carried out by the Engineer-for-Tests, Victorian Railways, while the chemical work was performed at the Geological Survey laboratory.

By way of comparison, the Victorian Railways specifications for Portland cement are also included under each test.

Tests on Finished Cement.

(*a*) Fineness—

Residue left on 5,776 sieve; Nowa Nowa sample	Nil
Victorian Railways specification	3 % allowed
Residue left on 32,400 sieve; Nowa Nowa sample	12·8 %
Victorian Railways specification	22·5 % allowed

(*b*) Specific gravity—

Nowa Nowa experimental sample ..	Specific gravity	3·28
Victorian Railways specification ..	,, ,, not less than ..	3·10

(*c*) Chemical composition—

Ratio of lime to silica and alumina—		
Nowa Nowa experimental sample ..	.. ..	2·04
Victorian Railways specification ..	Ratio not greater than ..	2·85
	nor less than	2·00
Nowa Nowa experimental sample ..	Magnesia (MgO)	0·91 %
Victorian Railways specification ..	,, ,, shall not exceed	4·00 %
Nowa Nowa experimental sample ..	Sulphuric anhydride (SO_3) ..	1·41 %
Victorian Railways specification ..	Sulphuric anhydride (SO_3) shall not exceed	2·00 %

(*d*) Test for tensile strength (lb. per square inch)—

(1) *Neat Cement.*

——	7 days.	14 days.	28 days.
	lb.	lb.	lb.
1	533	748	732
2	498	661	748
3	596	671	817
Average for Nowa Nowa sample ..	542	693	766
Victorian Railways specification ..	500	..	600

(2) *Mixed Cement.*

Sand	3 parts.
Cement	1 part.

——	7 days.	14 days.	28 days.
	lb.	lb.	lb.
1	127	209	233
2	137	199	260
3	139	182	231
Average for Nowa Nowa sample ..	134	196	241
Victorian Railways specification ..	150	..	250

The average breaking stress of the briquettes 28 days after testing shows an increase of—

41 per cent. for neat cement.
79·8 per cent. for mixed cement.

(*e*) Setting time—

Setting time (initial) ..	.. 1 hour 25 minutes.
Hard set	.. 12 hours (about).
Victorian Railways specification ..	Initial set—not less than 15 minutes.
,, ,, ,, ..	Hard set—not less than 1 hour nor more than 12 hours.

(*f*) Soundness—

Victorian Railways specification ..	Pats shall remain firm and hard and shall show no signs of distortion, abnormal curvature, cracking, or disintegration.
Nowa Nowa prepared cement ..	Air pat, Water pat, Steamed pat } All conform with above requirements.

(*g*) Chemical analysis—

Finished Cement.

	%
SiO_2	22·46
Al_2O_3	6·06
Fe_2O_3	8·93
MgO	0·91
CaO	58·20
Loss on ignition	1·18
SO_3	1·41
Alkalies	0·82
Total	99·97

Analyst—F. Moss, Geol. Surv. Lab., 1920.

It will be seen from the various tests that the cement complies with practically all Victorian Railways standard specifications, except one, that is the tensile strength of the mixed cement; in this case it just fails to reach the standard.

It is interesting to note the high percentage increase of the briquettes in this test between the 7 and 28 days, namely, 79%. The cement is slow setting, probably on account of an excess of gypsum retarder or improper grinding.

An analysis of the cement shows it to be low in lime content. It is probable that some of the ash from the fuel has entered into the clinker, adulterating the cement to a small degree; this would be rectified if the cement were burnt in a rotary retort, when a uniform clinker could be produced and allowance made for introduction of ash into the finished product.

The slate rock used was rather high in silica; the introduction of a third ingredient (clay) would overcome this difficulty.

Laboratory tests show that the raw materials from Nowa Nowa are capable of producing a cement of good colour which should pass the standard specification tests.

Before any developmental work is attempted, larger tests in a cement works should be undertaken to confirm the laboratory results; also, the area should be thoroughly prospected and tested to determine any great variety in the composition of the raw materials, and whether the size of the deposits justifies the large expenditure of capital necessary to establish a cement works. Possibly some local clay deposit might be suitable for mixing with the limestone in addition to, or in place of the Ordovician slate.

[4.8.20.]

SANDSTONE NEAR ATHLONE, SOUTH GIPPSLAND.

By D. J. Mahony, M.Sc., F.G.S.

Samples of Jurassic sandstone from Allot. 74, Parish of Longwarry, were submitted for examination. The stone is fine grained, of a pleasing cream colour, and some of the blocks had been trimmed into cubes, showing that it works well with the chisel and can be dressed to a smooth face. It is a soft rock, absorbs water quickly, and contains

some scattered filaments of black carbonaceous matter. When wet it has a strong smell of clay. Analyses were made of two samples, one cream coloured (796) and the other brownish (797).

——	796.	797.
	%	%
SiO_2	55·15	44·67
Al_2O_3	15·23	13·57
Fe_2O_3	4·49	4·87
FeO	0·98	2·76
MgO	2·79	3·82
CaO	5·43	9·97
Na_2O	1·16	1·18
K_2O	1·65	1·53
Loss on ignition	11·00	15·16
H_2O — (110° C.)	1·90	1·92
TiO_2	0·59	0·52
P_2O_5	Trace	Trace
MnO	0·22	0·62
SO_3	Nil	Nil
Total	100·59	100·59
Specific Gravity	2·09	2·23

Analyst—F. F. Field.

The high clay content indicated by the loss on ignition is probably unfavorable for resistance to weathering. Absorption was estimated by soaking small blocks in water and finding the percentage increase in weight. In one hour 796 absorbed 7% of water and 797.1.8%; these amounts increased to 9.44% and 4.11% respectively in 24 hours and to 9.89% and 4.14% in five days. Under this treatment a little of the rock disintegrated. Some of the rock was broken down and washed to get rid of the clay; and the residue, examined under the microscope, was found to consist of angular grains of quartz and some felspar.

The suitability of the stone for building purposes will depend on its weathering properties and on the size of the blocks that can be quarried. The stone appears to be well suited for use as an abrasive for paintwork, smoothing marble, &c.

The deposit from which the samples were obtained is situated close to the Lang Lang River, the valley of which is bounded on the northern side by a steep bank of Jurassic rocks forming cliffs in places. One of these cliffs is the proposed quarry site. The Jurassic beds are nearly horizontal, but are not very regular and are false-bedded in places. They range from fine arenaceous sandstones to coarse grits and frequently contain fragmentary plant remains which look like charcoal. Some weather to smooth faces, but others consist of layers of different hardness and assume rough laminated surfaces. In places they contain rounded concretions up to a couple of feet in length. The specimens sent to the Department are from a bed 30 or 40 feet from the top of the cliff. This bed where exposed is about 8 or 10 feet thick, weathers to a smooth face, and shows some signs of false bedding. Names and dates have been carved on it, the dates ranging back to some 30 years. The older carvings are considerably weathered but are still quite readable. Until some work is done it is impossible to

estimate how much stone of this type is available, but it is highly probable, judging by the texture and weathering of some of the beds, that a considerable proportion of waste would have to be removed in quarrying operations.

If a narrow face were quarried the full height of the outcrop, it would soon be evident whether the proportion of suitable stone is large enough to warrant further development.

The site offers every facility for a quarry with a face 100 feet high. It is about 300 yards from the railway, from which it is separated by the river and a flat alluvial plain.

[24.2.22.]

GRANITE AT COLQUHOUN, NEAR BRUTHEN.

By A. H. Sharpe.

Accompanied by Mr. Shirrefs, I inspected this outcrop of red granite, which at its nearest point is only some 3 chains distant from the 198 mile-post on the Bruthen-Orbost railway line and distant about 1 mile from the Colquhoun railway siding. The granite outcrop is lightly overlain with loam in circumscribed patches here and there and covers an area of about 6 by 8 chains or approximating 5 acres. From the bed of the creek the ground rises abruptly for about a chain and thence by a gentle incline towards the railway line, the difference in elevation between the granite in the bed of the creek and that of the highest outcrop being, I estimate, about 75 feet. Along a small portion of the bed of the creek situated within the 5 acres the granite bodies are exposed in horizontal as well as vertical section, disclosing "shakes" or partings of such frequent occurrence as to restrict the dimensions of the solid blocks of granite in sight to that of monumental masons' requirements. The tortuous rock-bound gully that constitutes the bed of the creek appears to be associated with disturbed country. On the other hand, the more sparsely distributed shakes or seams showing necessarily in vertical section, on the surface outcrops distant from the gully, suggest the strong probability of blocks existing suitable for building purposes if its crushing resistance is proved to be satisfactory. My views are that the nature and extent of this outcrop of red granite, also its quality, quantity, and ease of working, can be determined only by actual quarrying operations on a substantial scale.

[19.3.21.]

ST. ELMO GRANITE QUARRIES, CASTERTON.

By J. P. L. Kenny, B.C.E.

The St. Elmo Granite Quarries are situated at Wando Vale, about 8 miles north of Casterton railway station by a fair road. Work was started about two years ago by a syndicate, and operations were continued by the present company, which has now reached the producing stage. The precise site of operations is near the south boundary of Allotment 13, Section V, Parish of Wando. The country is undulating and the granodiorite rock which is being worked outcrops over an area of about 1 square mile.

Professor Skeats in a private report for the company describes the rock as a granodiorite composed of orthoclase and plagioclase felspars, quartz, biotite, muscovite, and small quantities of epidote, sphene, chlorite, apatite, and magnetite. Specific gravity, 2.68. Crushing strength of a 2-inch cube, 20,460 lb. (9.134 tons) per square inch. The rock is medium grained, grey in colour, and almost free from the dark patches which disfigure much of the granite from Harcourt, the present chief source of supply. It gives a good contrast between polished and axed faces. It has a higher crushing strength and works to a sharper arris or edge than Harcourt stone.

The quarry is now about 60 feet in diameter and 25 feet deep. From the surface to a depth of 10 to 15 feet the rock consists of weathered boulders in soft granite. Some of the boulders have been dressed to shape, but they have a tendency to give irregular faces, and the proportion of waste is high. Below the decomposed zone the rock which is being quarried shows a series of strong vertical joints, varying from 2 feet to 3 ft. 6 in. apart, with a north-easterly strike. The minor joints, approximately at right angles to these, are rather irregular both in strike and dip and have proved an uncertain factor in working. The close and irregular jointing has been a handicap, but an improvement in this respect may be expected as the quarry is further opened up. The stone cuts readily in a direction at right angles to the master joints, and blocks over 7 feet long have been prepared. Two blocks at the quarry ready for transport measured 7 ft. 4 in. by 2 ft. 7 in. by 1 foot and 6 ft. 8 in. by 2 ft. 8 in. by 1 ft. 3 in. respectively. The ground at the quarry site slopes to a gully about a chain away, and as the pit is located on the lowest portion of the lease work is hampered by want of room for the disposal of the waste rock and overburden. A tramway to a suitable tip at the level of the top of the solid rock offers the best means of removing the latter.

So far the company has not been able to dispose of the spalls produced in working. For heavy traffic they would give suitable metal, but are not favoured for the light traffic of a country road, as they give a rough and uneven surface. With a regular output from the quarry the question of providing a good road to the railway station will have to be considered. The quarry is equipped with two jib cranes of 6 tons and 10 tons capacity respectively, the latter is fully equal to all requirements.

At present all drilling is done by hand labour and the company is considering the installation of an oil engine and compressor. Such would undoubtedly effect economies in working, but I think its installation might be delayed pending further development of the quarry. Casterton is 245 miles distant from Melbourne, and the question of transporting the stones by sea from Portland, 70 miles from Casterton, seems worthy of consideration.

The points in favour of this stone as compared with Harcourt granite have already been enumerated; on the other hand, there are higher working costs, irregular jointing and the distance of the quarry from a railway station and from Melbourne. The quarry has now reached the producing stage; and where a high grade stone is required this rock should be eminently suitable for monumental and building work.

[9.7.19.]

BULLENGAROOK SLATE QUARRY, NEAR GISBORNE.

By D. J. Mahony, M.Sc., F.G.S.

The quarry is situated in Allotment 43B, parish of Bullengarook, on the north side of the Saltwater River, about 6 miles from Old Gisborne township, to which it is connected by road. The rocks consist of slates and sandstones of Ordovician age which have been considerably folded, and in which nearly vertical slaty cleavage is highly developed.

The bed of slate and the adjacent strata are folded into a well defined syncline which pitches north. The workings are on a steep hillside. Two varieties of slate are worked, one dark grey in colour and the other blue.

The Dark Grey Slate.

The dark slate was worked some thirty years ago, and the old open cut and tunnels show that a considerable amount was removed.

The bed is about 9 feet thick and is formed of five layers, three of which are useless on account of pyrites. The remaining two parts produce slates of excellent appearance readily cleavable into the sizes generally used for roofing. Some of it was used in Gisborne and is said to be quite satisfactory after many years, exposure to the weather. In certain parts of the old tunnels, however, the slate has decomposed at the surface to a soft powdery mass, probably owing to the oxidation of pyrites. At other places there are efflorescences of magnesium sulphate. A sample was analyzed in the Geological Survey Laboratory.

SiO_2	76.08
Al_2O_3	10.56
Fe_2O_3, FeO	3.71
MgO	1.88
CaO	trace
Na_2O	trace
K_2O	2.56
H_2O above 110° C.	2.62
H_2O at 110° C.	0.45
Co_2	nil
TiO_2	0.45
SO_3	nil
FeS_2	nil
C	1.50
	99.81
Sp. Gr.	2.64

It appears that the old company worked the 9-ft. bed from an open cut until the northern pitch of the syncline and the southern slope of the ground made this method too expensive on account of the large quantity of useless rock that had also to be removed. Tunnels were then driven and the slate was stoped out like a quartz reef till the mine was abandoned. The present company, which began work about two years ago, stoped out most of the slate readily available from the lower tunnel, and then turned its attention to the other slate body. Further operations on the 9-ft. slate would probably be unprofitable.

The Blue Slate.

The company is now opening a bed of blue slate on the eastern limb of the syncline about 15 feet east of the 9-ft. slate, from which it is separated by sandstone beds. The blue slate is softer than the

dark slate and can be scratched with the finger nail. It cleaves readily and appears to contain very little pyrites. It has been used for school slates and is said to have given satisfactory results, but has not been used for roofing. Whether it will prove suitable for this purpose in regard both to weathering and durability of colour is best proved by actual use, and I would suggest that it be used on the roofs of sheds at the quarry. It may become harder at a depth from the surface, but no very marked change of this kind can be expected.

This slate is exposed in a cutting on the slope of the hill near the old tunnel in the eastern limb of the dark slate. At a lower level a cut is being made, and lower again a shaft sunk to a depth of about 20 feet. The exact thickness of the bed has yet to be determined, but it appears to be between 20 and 30 feet. It is proposed to drive north from the bottom of the shaft and then to stope above the drive to the surface, making an open cut, the face of which can be kept a little behind that of the surface cut now in progress, giving two benches.

The blue slate bed will curve round the syncline, and this is likely to cause difficulties as depth is attained, since the western wall of the quarry will be overhanging. A rough estimate of quantity, if it is assumed that the slate is 20 feet thick and that a 50-ft. face can be worked, gives approximately 200 tons for every yard that the face is advanced. The usual proportion of finished slates to slate quarried is 20 per cent or less, so that 200 tons of quarried material should yield about 40 tons of finished slates.

If the blue slate proves satisfactory in quantity and quality where it is now being opened out, it should be looked for on the western side of the old open cut, where it will come to the surface after folding under the syncline.

[6.10.21.]

CLAY DEPOSITS OF THE BALLARAT DISTRICT.

By W. Baragwanath.

The clays may be classed geologically as—

A. *In situ*—

1. Decomposed granite.
2. Decomposed strata (metamorphic and normal).
3. Decomposed dykes, (*a*) acidic, (*b*) basic.

B. Transported—

1. Prebasaltic clays — detritus from granite masses and
2. Post basaltic clays — Ordovician strata.

Dealing with these deposits in order we find:—A1. Decomposed granite (china clay) west of Lintons, near Pittong, at Warrenheip, Yendon and Lal Lal. At each of these localities the granite has decomposed to a soft kaolin with free quartz; the bulk of the mica has been removed; iron stains exist near the surface, but are absent at a depth of a few feet.

A2. Decomposed strata (metamorphic). This material is used at Lal Lal, and comprises white and blue beds overlain by from 6 to 10 feet of clay. The strata are soft to the depth worked, and semiplastic. Normal strata in the vicinity of Ballarat to a depth of over 100 feet contains sufficient clayey material to bind in use for bricks, &c.

A3. Decomposed dykes. Of the acidic group, the felspathic dykes at Ballarat East (the " pug " and the " sediment ") formed tough clay in the upper portions. A larger dyke of this class, the Yorkshire, $\frac{1}{4}$ mile north-east of Black Hill attains a width of 15 feet and is traceable for a length of over 30 chains; the outcrop of this dyke now forms a white clay. Basic dykes in the mines of Ballarat East cut across the strike of the beds. To a depth of 500 feet the dykes are altered to a yellow clay. The outcrop of a dyke of this class was noticed in dredge workings in Little Bendigo Creek about 10 chains north of the junction with the Yarrowee Creek, where a tough yellow clay was formed. At the Salt Spring north of Brown Hill Hotel a similar dyke, but decomposed to a light coloured clay, was noted. In workings east of the Grey Horse Coy's No. 3 shaft a decomposed lamprophyre dyke forms a pink clay 2 feet wide. At St. James Hill, a nob on the divide at the head of the Yarrowee Creek, a dyke of gritty kaolin occurs in an old adit; this dyke is probably one of the basic type. Near Spargo Creek Hotel, in a tunnel driven east of the Werribee River a decomposed dyke several feet in width is exposed. At Egerton and to the north-east dykes of this class are mined for kaolin. At Snake Valley a nearly horizontal dyke 3 to 6 feet wide is being worked. At Lal Lal, 40 chains west of the old iron mine, a dyke several feet wide was mined for kaolin, of which 750 tons were sent to England prior to the removal of the tramway line to the Iron mine. Many such dykes occur throughout the bed rock, but where intersected by mining operations, unless of exceptional purity, little notice is taken of them by the miners, with the result that many are not recorded. The quantity of clay available from this source, however, is always limited.

B1. Transported clays, prebasaltic. These clays are not exposed in the immediate vicinity of Ballarat, their place being taken by coarse detrital deposits forming portions of the deep leads and reef washes. At from 3 to 8 miles south of Ballan, and similarly at Berringa, fine white and coloured clays of this age occur at shallow depths, and cover large areas.

The clays of the Lal Lal basin overlying the lignite beds form a connecting link with those of the post-basaltic group. In this basin the overburden consists of 60 feet of clay and drift, the clays being white, yellow and blue in colour, and derived from the granite and bed rock adjoining. Although proved to cover several hundred acres, and by tests to be of good quality, no attempt has been made to exploit these extensive beds. One layer was known prior to 1861 to form an exceptionally pure fireclay, but was not exploited.

B2. Post-basaltic transported clays form the bulk of the deposits which accumulated in the several lakes or dams formed by the volcanic outpourings in the vicinity of Ballarat. These clays occur at Ballarat East. Mt. Pleasant, along the eastern bank of the Yarrowee, on the eastern side of the Creswick railway line at Ballarat North and to near Mt. Rowan, in the vicinity of Creswick; north of North Creswick, as well as plentifully elsewhere. The clays are usually of a mottled colour, frequently yellow, red and white, and vary in thickness from a few inches to upwards of 100 feet. In burning, these clays give varying shades of terracotta and red, but, apart from use in brick making, have not been much tried for tile and pottery making. The layers near the surface occasionally contain a small quantity of angular quartz. In

dredge operations these clays are washed down, mixed and carried away by the water into settling dams, where, if gravel and sand had been deposited separately, many thousand tons of clay of good quality would now be available; but owing to the method adopted of storing all silt, soil, clay, sand, gravel and boulders in the same dams, the result is not satisfactory, and the clayey deposits in these dredge workings are not as uniform as is desirable. The uppermost layers in the dredge dams, formed by the low settling of the clayey particles which were long held in suspension in the dirty water, are in places clays of great plasticity.

Geological Occurrences.

The decomposed granite at Pittong, near Lintons, forms portions of a large granite area which extends eastwards towards Lintons and southwards for many miles. The area now being worked by O'Meara lies within half a mile of the northern limit of the mass. At Warrenheip a small area about half a mile to the west of Warrenheip station forms one of the few places where the decomposed granite can be seen, but surface indications suggest that a large area, probably covered by only a few feet of surface soil, connects to Yendon, and also (overlaid in part by basalt) to Lal Lal. Near Yendon a few feet of surface soil overlies the soft decomposed granite. At Lal Lal on the north-western margin of the old swamp a few feet of peaty soil covers the granite, while to the south-west of Knight's clay pit a few feet of clay is to be seen resting on the decomposed granite in the kaolin pit. About a mile eastwards two pits prove the granite to be decomposed at a few feet below the level of the old swamp.

Although the decomposed granite occupies a width of many chains in each of these localities, the hard unaltered rock is usually in the vicinity, and in these portions search for china stone might be made. As favourable localities the Stony Rises near Lake Learmonth, and the Mt. Bolton Ranges offer inducements; also near Lintons; the area of granite exposed near Gong Gong, and to the west of Lal Lal, also on the Moorabool River below the Lal Lal Falls, the area being small.

The only locality where metamorphic strata have been worked is at the Lal Lal Firebrick Company's pit. Some white beds of metamorphic strata at Snake Valley afford a good whiting, and are fairly plastic.

The chief dyke of the acidic group is the Yorkshire, situated between Black Hill and Little Bendigo, which attains a width of 15 feet and is to a depth of 50 feet entirely decomposed to a highly siliceous clay of a white colour and high refractory nature. The southern continuation of this dyke passes through Pennyweight and Clayton Hills and is reputed to have been intersected by a cross-cut from the Exchange shaft and proved to be 30 feet in width. Below a depth of 50 feet the dyke burns to a fine terracotta colour.

The basic dykes, while they afford good coloured plastic clays, are small when cutting across the strata, the largest outcrop of this class being at the salt spring near Brown Hill Hotel. At Snake Valley a nearly horizontal dyke with a southerly pitch is being worked by the Carngham Whiting and Kaolin Co. This dyke is now kaolin of uniform texture and of a cream colour. At Mt. Egerton a kaolin dyke striking north and south with the strata yields kaolin of a pure white colour. North and south of the chief workings (Miss Malone's) smaller dykes of

similar material occur, while to the north-east, at Vaughan's workings, the dyke is from 2 to 4 feet wide, but varies in colour from white to yellow.

Clays tested at the Geological Survey Laboratory from Ballarat district:—

Whiteware Clays (for porcelain, artistic, and chemical ware).
Gordons, 1908/309, 1908/392.
Egerton, 1905/114, 1905/163, 1905/164, 1908/538.
Snake Valley, 1914/416.
Lal Lal, 1905/74, 1905/76, 1905/94, 1905/98.
Elaine, 1905/114.

Certain Egerton, Snake Valley and Elaine kaolins burn white. The Gordons and Lal Lal kaolins are not quite white.

Refractory Clays (firebricks, crucibles, &c.).
Lal Lal, 1905/74, 76, 94, 96, 98, 103, 330.
Lintons, 1913/65, 336.
Ballarat, 1907/438, 1913/68.

The Ballarat fireclay appears to be void of free silica and should stand a very high temperature in the presence of basic slags. The same remark applies to some of the Lal Lal clays.

Vitrifiable Clays for Stoneware (bottles, jars, filters, &c.).
Bungaree, 1904/260, 261, 262.
Lal Lal, 1908/53, 1910/510-514, 1912/309, 1913/325, 329, 330, 1941/187.
Egerton, 1905/224.
Morrison, 1905/225.
Berringa, 1905/459-461.
Warrenheip, 1912/365.

Pottery Clays (white, terracotta).
1915/289.

Brick Tile and Terracotta Clays (red and pink).
Lal Lal, 1905/94, 95, 96, 97, 187.
Gordons, 1906/311, 394.
Ballarat, 1907/435, 1912/363, 364.
Snake Valley, 1914/507.
Lintons, 1913/337.
Bradshaws Creek, 1912/535.
Egerton, 1905/223.

A1. Decomposed Granite.
Lintons (Pittong), 1913/65.
Warrenheip, 1912/365.
Lal Lal.

A2. Decomposed Strata (metamorphic).
Lal Lal, 1910/510, 511, 512, 513, 514, 1913/329-330, 1914/187.

A3a. Decomposed dykes (acidic).
Yorkshire dyke, 1907/435,438.

A3b. Decomposed dykes (basic)
Little Bendigo, 1907/434, 436, 437.
Snake Valley.
Spargo Creek.

B1. Prebasaltic clays but little exposed on the surface and limited in extent in the immediate vicinity of Ballarat.

Berringa, 1905/458 (yellowish), 459, 461 (white).

B2. Post basaltic clays.

Ballarat East typical sample, 1912/363-364.

As typical samples the following tests may be given:—

1813/65. Decomposed granite from Pittong, near Lintons. The sample consisted of decomposed granite with kaolinized felspar. It contained clean quartz grit which was separated from the white clay portion. The proportions were—

Quartz grit, 56 per cent.

China clay, 44 per cent.

The quartz is white to grey in colour. Test pieces were made up of the material after crushing fine, including the quartz (A), and also of the fine white washed clay free from grit (B). These pieces were dried and treated at various temperatures, as follows:—

——	—	A.	B.
Air dried	Colour ..	White	White
	Shrinkage	4 per cent.	6 per cent.
Muffle heat 1100° C...	Colour ..	White	White
	Shrinkage	4 per cent.	11 per cent.
		Soft biscuit ..	Harder biscuit
Wind furnace 1340° C., after muffle; twice burned	Colour ..	Dull white	White, slight iron stain (superficial)
	Shrinkage	11 per cent. ..	25 per cent.
		Moderately hard ..	Dense, hard
Wind furnace 1340° C., once burned	Colour ..	Dull white	White, slight iron stain (superficial)
	Shrinkage	11 per cent. ..	25 per cent.
		Moderately hard ..	Dense, hard

The clay is semi-plastic. The tests indicate that the material would be of value for the manufacture of pottery and china ware if properly treated and existing in sufficient quantity. The washed material represents very pure china clay with very little iron. The shrinkage is high. Further tests have been made by compounding the washed material with felspar—the tiles burned well and evenly. Experiments made by applying hard and soft glazes showed that the clay takes the glaze well and is suitable for the manufacture of tiles and other glazed ware.

Samples taken from Lal Lal fire brick and pottery pit derived from metamorphic strata (1913/329, 330.).

Sample 329. Dull white non-plastic clay with very small amount of grit.

Sample 330. Bluish-white semi-plastic clay; no grit.

Both samples were broken down and made into briquettes and tiles for burning tests which were made at various temperatures.

——	—	329.	330.
Air dried	Shrinkage Colour ..	1 per cent. .. .. White ; soft ..	4 per cent. Blue ; firm hard
Muffle 1100° C. ..	Shrinkage Colour ..	1 per cent. .. .. White soft biscuit ..	5 per cent. White hard biscuit
Wind furnace 1340° C., after muffle Wind furnace 1340° C., overburned	Shrinkage Colour ..	12 per cent. .. Greyish-white, vitrified	10 per cent. Yellowish-white, semi-vitrified

No. 329 is a non-plastic clay which burns to a hard, semi-vitrified tile of a dull white colour. It does not show iron stains on burning and should be a suitable material for pottery ware, majolica ware, tiles, &c. The shrinkage is moderate.

No. 330 is a semi-plastic clay which on burning shows slight iron staining. The shrinkage is less than No. 329, but the colour is not so good. This material would be suitable for common stone ware, Bristol ware, &c.

1907/435. Sample of dyke from tunnel level 80 feet below surface, Yorkshire dyke—

——	Shrinkage.	Colour and Remarks.
	%	
Air dried	3·0	Yellowish-white, no grit
Muffle heat 1100° C.	6·0	Fine light red
Muffle heat 1100° C., and reburnt in furnace 1450° C.	16·0	Black overburnt
Single furnace burning 1450° C. ..	16·0	Black overburnt

This clay would be very suitable for the manufacture of terracotta material, tiles, &c. The colour at the lower temperature is very good and the shrinkage low.

1907/438. Sample of dyke from surface outcrop, Yorkshire dyke—

——	Shrinkage.	Colour and Remarks.
	%	
Air dried	3·0	Yellowish-white
Muffle heat 1100° C.	4·5	White
Muffle heat 1100° C., and reburnt in furnace 1450° C.	4·5	Light yellow
Furnace burning 1450° C. ..	4·5	Light yellow

This clay appears to be eminently suitable for a fire clay. It is plastic and binds well. Shrinkage is low and there is no sign of fusion at the highest firing.

Sample taken from basic dyke, Salt Spring, Brown Hill (1907/437)—

——	Shrinkage.	Colour and Remarks.
	%	
Air dried	8·0	Light colour, yellow tinge
Muffle 1100° C.	16·0	Light brown
Furnace 1450° C., after muffle ..	16·0	Slate blue ; slightly vitrified
Furnace direct 1450° C.	16·0	Greyish-white ; slightly vitrified

Suitable for common stone ware.

Another sample taken from this same line of dyke but half a mile west in Little Bendigo Creek (1907/436)—

——	Shrinkage.	Colour and Remarks.
	%	
Air dried	8·0	Fine light yellow clay ; plastic
Muffle 1100° C.	14·5	Fine dark red colour
Muffle 1100° C., and reburnt 1450° C.	19·0	Black overburnt ; slightly vitrified
Furnace direct 1450° C.	19·0	Black overburnt ; slightly vitrified

This clay would make an excellent tile and terracotta clay. It contains no grit.

White clay from depth 10-20 feet, Berringa (1905/459-461). Although very siliceous, this clay works up readily into shape and dries to a firm white briquette. Shrinkage is slight—

——	Shrinkage.	Colour and Remarks.
	%	
Air dried, four weeks	3·0	White
Muffle at 1100° C.	7·5	Light yellow
Muffle and wind furnace 1450° C. ..	7·5	Grey ; fused
Furnace direct	7·5	Grey ; fused

At the lower temperatures a firm hard briquette was produced which had the appearance of a good fire clay; at the higher temperature a heavy surface glaze developed, which makes this material of no value as a fire clay. The shrinkage is very small, however, and this clay might find a use for some grades of pottery. The fusion effect is due to the presence of alkalies (potash 1.34 per cent.), and probably also to magnesia.

Analysis of 1905/461.	Percentage.
Silica (SiO_2)	80·84
Titanic Acid (TiO_2)	Trace
Alumina (Al_2O_3)	12·33
Ferric Oxide (Fe_2O_3)	1·53
Ferrous Oxide (FeO)	Nil
Lime (CaO)	Nil
Magnesia (MgO)	0·87
Soda (Na_2O)	0·28
Potash (K_2O)	1·34
Water (H_2O) at 110° C.	0·82
Water (H_2O) ignition	2·86
Chlorine and Phosphoric Acid ..	Trace
Sulphur Trioxide	Nil
	100·87

As typical of the post basaltic clays, the two following samples may be taken :—

1912/363, from 2 feet to 6 feet below surface.
1912/364, from 6 feet to 25 feet below surface.

Yellow, red and grey mottled ferruginous clay with gritty particles.

—	Air Dried.	Muffle 1100° C.	Wind Furnace 1340° C. after Muffle.	Wind Furnace 1340° C. Direct.
363. Shrinkage	8 per cent.	14·5 per cent.	19 per cent. ..	14·5 per cent. swollen
Colour ..	Brown ..	Fine red ..	Black, overburned, vitrified	Black, overburned, vitrified
364. Shrinkage	8 per cent.	12·5 per cent.	14·5 per cent. ..	14·5 per cent.
Colour ..	Light red	Terra-cotta..	Black, overburned, vitrified	Black, overburned, vitrified

No. 364 would form an excellent material for superior brick or tile. No. 363 produces a fine red colour on burning, No. 364 being of a lighter shade, but firm and easily worked. Care will be required in burning not to exceed a temperature of about 1,200° C.

[10.6.18.]

O'DONNELL'S CLAY DEPOSIT, KINGOWER.

By H. S. Whitelaw.

O'Donnell's clay areas are situated at the head of Long, Frenchman's, and Evans' Gully leads, a trifle over a mile north of Kingower, which is a hamlet 7 miles south-west of Inglewood. The deposits, about half a square mile in extent, overlie and flank the auriferous gravels on the northward slope for a width of about a mile. They consist of common pipe-clay (decomposed Ordovician bed-rock) and water-borne yellow, brown and red clays with here and there a patch of heliotrope as seen at the surface and on the sides and mullock-tips of old alluvial shafts. In physical properties they much resemble the clays that are now being profitably wrought at a depth of about 30 feet in Sherrif's claim at White Hills, Bendigo, samples of which have been analyzed at the Mines Department laboratory.

At no spot, during my visit to the place, could a clean face of the material be examined where exposed in the shafts, which mostly contained water. The reds are superficially discoloured and striped by lighter-coloured rain-carried mud, while that portion which outcrops at the surface, or has been raised from the workings, has become hardened and dulled by the weather. When broken, however, this latter portion generally exhibits an even texture and a rich colour, and when mixed with water becomes plastic and capable of being moulded. Much of the surface of the red area is strewn with pisolitic iron. These grains are apparently of clay-ironstone, and have been leached out of the coloured bands in which they appear as wheat-like inclusions. It will be for experiment to show whether if the material be finely ground the effect of these would be neutralized. They are not present, however, in all the rock, there being fair-sized patches in which, so far as can be judged from superficial examination, there are no objectionable ingredients.

The deposits are favorably situated for economical working by open cut. The reds occur, generally speaking, at between 3 and 12 feet below the surface, the miners of the locality giving the average thickness as about 6 feet. The yellow at Evans' lead, it is said, occurs side

by side with the red, a clean line of demarcation dividing the two underground in such a way that in one drive they could be mined separately. This may be so at the place indicated, but occasionally at the surface and in shallow holes the red can be seen to merge insensibly through brown-red to yellow and lighter, the one exposure showing all gradations.

Samples of different varieties were tested at the Geological Survey laboratory, and the following reports were furnished by Mr. J. C. Watson. None of the samples are suitable for making first-class pottery or pigments.

Pigment Tests.

The samples were ground and passed through a fine mesh sieve. The presence of grit (quartz and ironstone) made the grinding difficult and slow. The raw and burnt sieved pigments were made up into paints with oil and tested for colour, covering power, and staining properties.

No.	516.		517.	
—	Raw.	Burnt.	Raw.	Burnt.
Colour	Brownish red	Brownish red	Brownish red	Brownish red
Covering power ..	Poor	Poor	Poor	Poor
Staining power ..	,,	,,	,,	,,
Iron content (Fe_2O_3)	31·1%	..	15·1%	..

No.	518.		519.	
—	Raw.	Burnt.	Raw.	Burnt.
Colour	Brownish red	Brownish red	Dard red	Dark red
Covering power ..	Poor	Poor	Very poor	Very poor
Staining power ..	,,	,,	,,	,,
Iron content (Fe_2O_3)	30·2%	..	35·8%	..

No.	520.		521.	
—	Raw.	Burnt.	Raw.	Burnt.
Colour	Purple red	Dark red	Dark red	Dark red
Covering power ..	Poor	Poor	Poor	Poor
Staining power ..	,,	,,	,,	,,
Iron content (Fe_2O_3)	21·6%	..	30·7%	..

No.	522.	
—	Raw.	Burnt.
Colour	Dark red	Dark red
Covering power ..	Poor	Poor
Staining power ..	,,	,,
Iron content ..	38·2%	..

These samples have no commercial value as pigments for oil paints.

Physical Properties.

Sample No.	1145.	1172.	1173.	1174.
Colour (dry) ..	White	Dark grey	Dull white	French grey
Colour (moist) ..	,,	,,	Pale grey	Dark grey
Texture ..	Fine-grained	Fine-grained	Fine-grained	Fine-grained
Plasticity ..	Poor	Poor	Poor	Poor
Slaking ..	Readily	Slowly	Readily	Readily
Grit	Little	Nil	Nil	Nil
Water required	39%	36%	36%	33%

Fire Tests.

The clays were tempered to give stiff workable bodies, soured for three weeks, made up into standard bricklets and tiles and burned at various temperatures.

No.	1145.	1172.	1173.	1174.
Test 0. Air-dried—				
Colour	Dull white	Dark grey	Dull white	French grey
Shrinkage ..	3%	4%	1·0%	3·0%
Condition ..	Low tensile strength, poor bond	Low bond	Very poor bond, low tensile strength	Low bond
Test 1. Oxidizing atmosphere, 1050° C.; Cone 05—				
Colour	White	Pink	White	Pale pink
Total shrinkage ..	4·0%	9·0%	2·0%	3·0%
Fire shrinkage ..	1·0%	5·0%	1·0%	Nil
Absorption ..	35·5%	28·0%	31·0%	34·8%
Condition ..	Soft biscuit	Soft bricks, cracked	Very soft bricks	Soft biscui
Test 2. Oxidizing atmosphere, 1110° C.; Cone 02—				
Colour	White	Pale pink	White	Dull white
Total shrinkage ..	7·0%	10·0%	4·0%	6·0%
Fire shrinkage ..	4·0%	6·0%	3·0%	3·0%
Absorption ..	30·6%	27·1%	24·1%	29·5%
Condition ..	Soft biscuit	Soft, cracked	Firm bricks	Soft biscuit
Test 3. Oxidizing atmosphere, 1150° C.; Cone 1—				
Colour	White	Pale pink	Dull white	Pale grey
Total shrinkage ..	10·0%	14·0%	13·0%	12·0%
Fire shrinkage ..	7·0%	10·0%	12·0%	9·0%
Absorption ..	23·9%	19·1%	10·5%	16·7%
Condition ..	Firm biscuit	Firm body, small cracks	Steel hard, vitrified	Hard biscuit
Test 4. Oxidizing atmosphere, 1210° C.; Cone 4—				
Colour	White	Pale pink	Pale grey	Grey (speckled)
Total shrinkage ..	11·5%	17·0%	15·0%	15·0%
Fire shrinkage ..	8·5%	13·0%	14·0%	12·0%
Absorption ..	20·3%	13·1%	1·1%	8·8%
Condition ..	Firm biscuit	Hard brick, cracked	Steel hard, vitrified	Steel hard
Test 5. Oxidizing atmosphere, 1270° C.; Cone 7—				
Colour	White	Pale grey	Pale grey	Grey (speckled)
Total shrinkage ..	12·5%	18·0%	15·0%	17·0%
Fire shrinkage ..	9·5%	14·0%	14·0%	14·0%
Absorption ..	14·4%	11·2%	0·4%	5·4%
Condition ..	Hard biscuit	Steel hard, cracked	Steel hard, vitrified	Steel hard, vitrified
Test 6. Oxidizing atmosphere, 1330°: Cone 10—				
Colour	Cream	Chocolate	Pale grey	Brown
Total shrinkage ..	17·0%	16·0%	Swollen	16·0%
Fire shrinkage ..	14·0%	12·0%	..	13·0%
Absorption ..	4·2%	5·2%	3·1%	3·7%
Condition ..	Steel hard, vitrified	Steel hard, iron spot	Overburned, vitrified, steel hard, vesicular, dull glazed surface	Steel hard, over burned, rough surface, iron spot

1145. The clay is difficult to work, and for commercial use would require blending with a ball clay to improve its plasticity and bonding properties. The sample burns to a good white, porous body, and is classed as a white earthenware clay.

1172. The sample does not appear to have any favorable qualities which would suggest its use as a pottery clay.

1173. Difficult to work up, and test pieces require very careful handling. The clay should be blended with a bond or ball clay to improve its tensile strength. Classed as a stoneware clay.

1174. Does not appear to have any commercial value as a clay.

The following samples sent for examination have no commercial value:—

1141. Hard vari-coloured ferruginous rock.

1142. Soft grey decomposed siliceous rock.

1143. Hard yellow ferruginous rock.

1144. Hard ferruginous rock.

[7.7.21.]

CLAY AT CHELTENHAM.

By R. A. Keble.

The deposit of clay inspected is situated on the property of A. W. Adams, at the corner of Cavanagh and Argus streets, about a mile east of the Cheltenham railway station. The road from the railway siding at Cheltenham is made to within a few chains of the deposit.

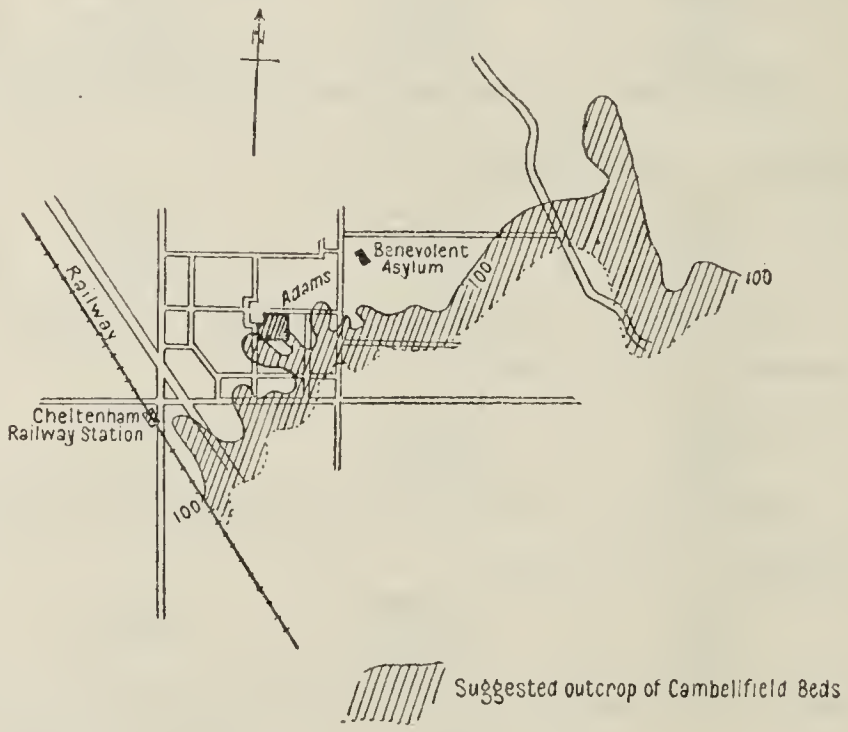


FIG. 135. Locality plan.
Scale: 2 miles to 1 inch.

There is little indication of the existence of the clay at the surface, but a shallow shaft and some bore holes on Adams' property and an old shaft and well on the adjoining land to the east affords sufficient

information to classify the deposit and to ascertain approximately the quantity readily accessible.

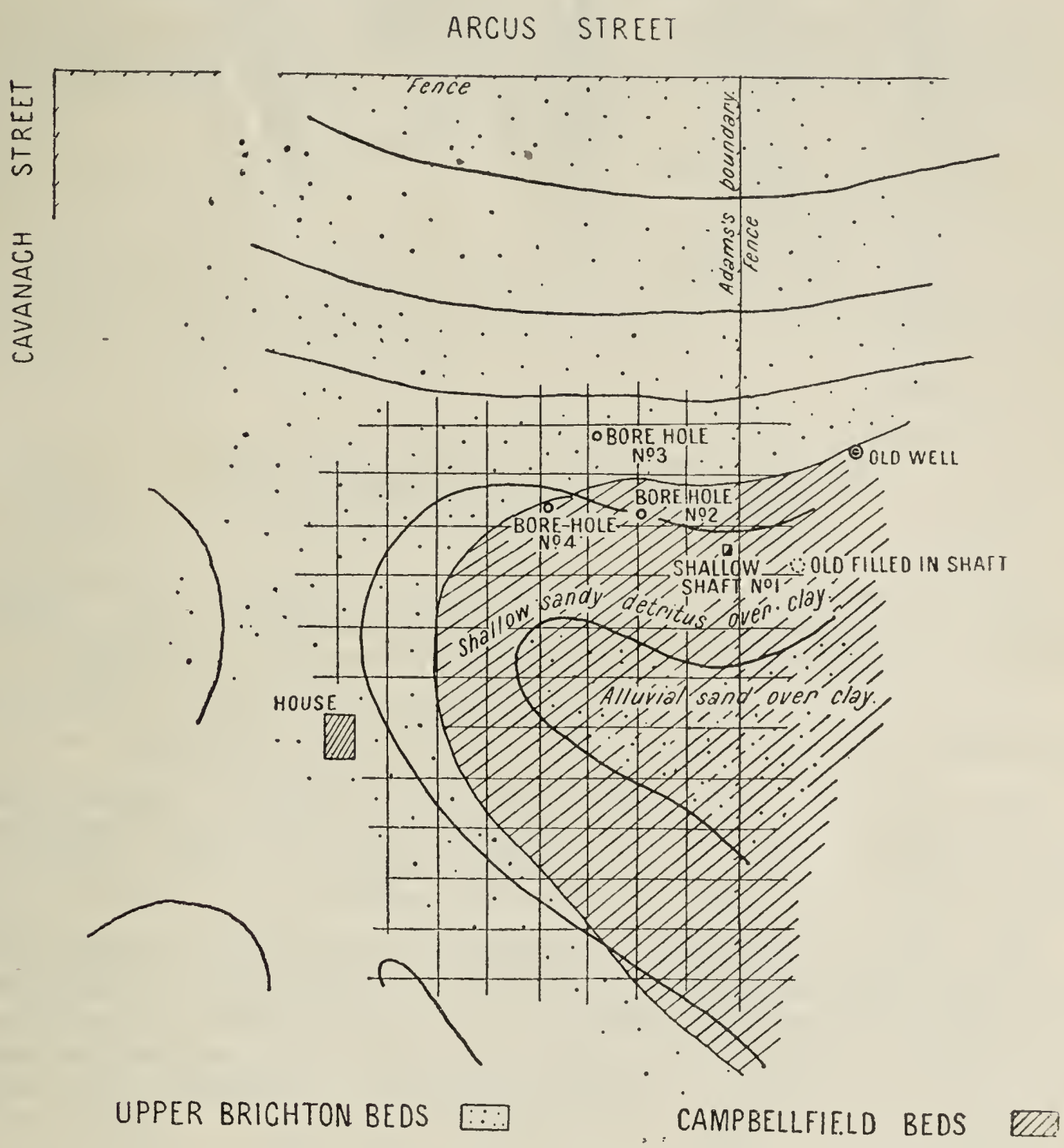


Fig. 136. Plan. Each square represents 371 surface cubic feet or 20 tons of clay. Scale : 100 feet to 1 inch. Five foot contours.

The following are sections of the bore holes and shallow shaft. The records of the bores were communicated by A. W. Adams, who put them down.

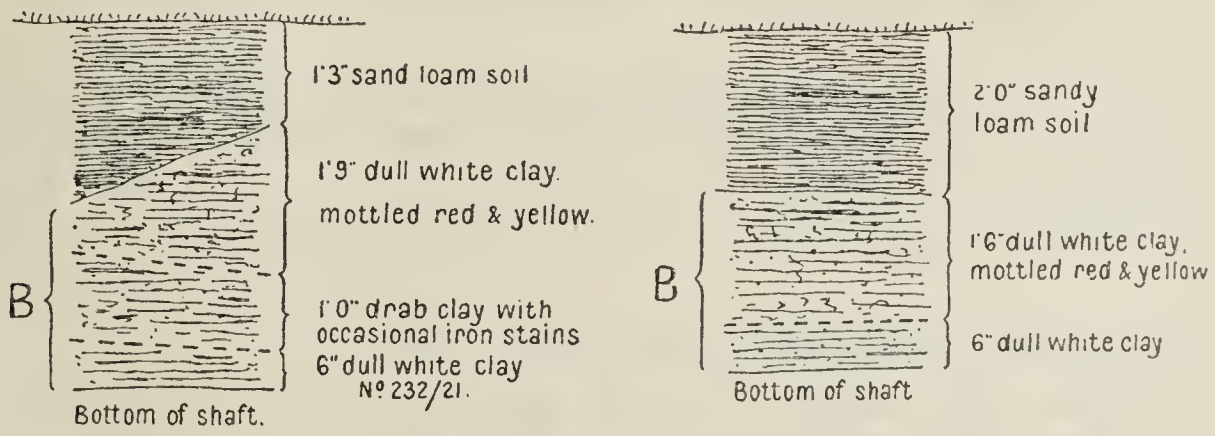

1'3" sand loam soil
1'9" dull white clay mottled red & yellow.
1'0" drab clay with occasional iron stains
6" dull white clay
No 232/21.
B
Bottom of shaft.
2'0" sandy loam soil
1'6" dull white clay, mottled red & yellow
6" dull white clay
B
Bottom of shaft

Fig. 137. Section in shallow shaft. Left, north side ; right, south side. Scale : 2 feet to 1 inch.

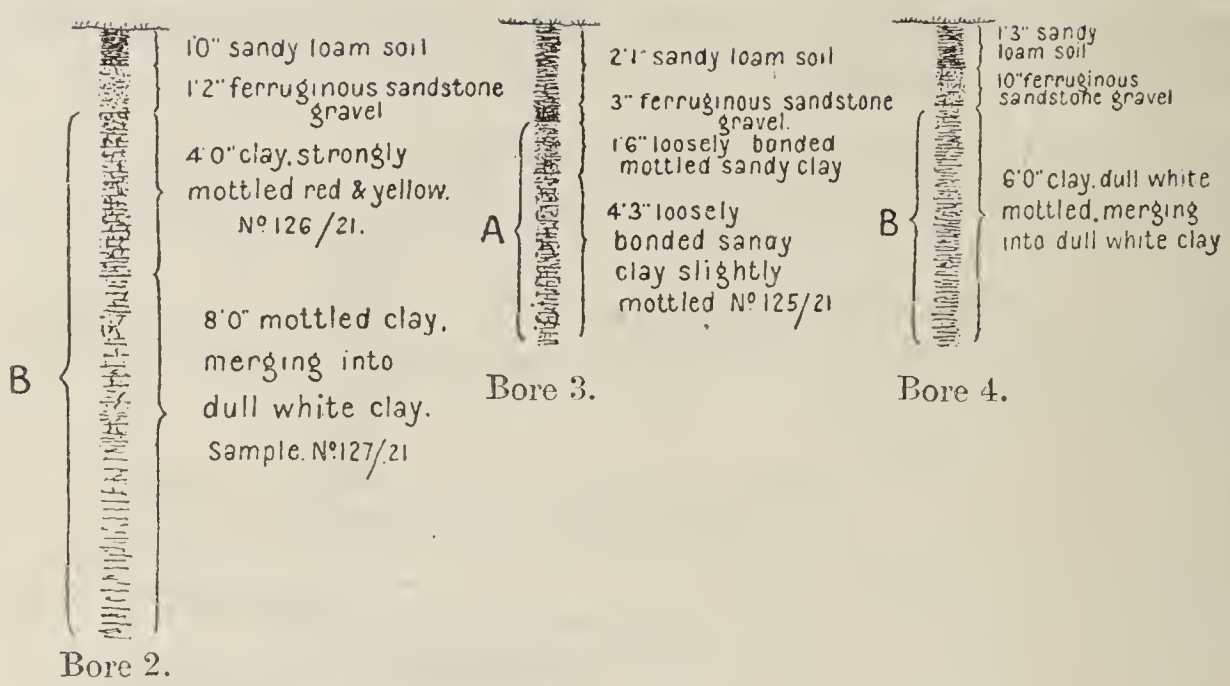

B
10" sandy loam soil
1'2" ferruginous sandstone gravel
4'0" clay, strongly mottled red & yellow. No 126/21.
8'0" mottled clay, merging into dull white clay. Sample. No 127/21
Bore 2.
A
2'1" sandy loam soil
3" ferruginous sandstone gravel.
1'6" loosely bonded mottled sandy clay
4'3" loosely bonded sandy clay slightly mottled No 125/21
Bore 3.
B
1'3" sandy loam soil
10" ferruginous sandstone gravel
6'0" clay, dull white mottled, merging into dull white clay
Bore 4.

Fig. 138. Sections of bores. Scale : 4 feet to 1 inch.
A Upper Brighton beds. *B* Campbellfield beds.

In these sections, A represents the basal sediments of the Upper Brighton beds (loosely compacted ferruginous sandstones) which rest on B, the Campbellfield beds (extremely fine-grained siliceous clays).

Along the gully which falls south-easterly into Carrum Swamp the sandstones have been removed from the clays by denudation.

The clay of the Campbellfield bed when pulverized between the fingers seems to be gritty, but on further attrition it works down into an impalpable powder. It is extremely tough and, *in situ*, appears to form a surface skin when exposed to the weather.

The overlying ferruginous sandstones (sample 125) have been the means of freely staining the upper few feet (sample 126) of the underlying clay with iron oxide, which has found its way along the joints and root channels. This staining disappears with depth, and in the lower layers (127 and 232) is scarcely perceptible. A minute steel blue mineral, probably ilmenite, is visible with a lens.

The deposit on Adams' property is advantageously situated for working. A face is possible in every direction except the south-east. The overburden is greatest to the north ; to the west and south it is less than 10 feet thick. The easily accessible portion on Adams' property comprises about 20,000 square feet. Assuming that the whole of the clay may be used, the quantity obtainable by removing the surface from this area is over 1,000 long tons. The squares on the plan represent 20-ton surface cubic feet.

The estimate of quantity is based on the specific gravity of a sample from shallow shaft No. 1, namely, 1.93, as ascertained at the Geological Survey laboratory.

The following tests were made in the Geological Survey laboratory :—

125. Red and yellow clay from bed A, bore 2.

126. Pale yellow clay from bed B, bore 2.

127. Dull white clay from bed B, bore 2.

232. Dull white clay from bed B, shaft No. 1.

No.	125.	126.	127.	232.
Colour (dry) ..	Brownish yellow	Pale yellow	Dull white	Dull white
Colour (wet) ..	Light terra-cotta	Dark yellow	Dull white	Light grey
Texture ..	Medium	Fine	Fine	Medium
Plasticity ..	High	High	High	Fair
Slaking ..	Slowly	Slowly	Readily	Slowly
Grit	Little	Nil	Little	8%
Water required	23%	26%	20%	25%

The clays were tempered to give stiff bodies. After souring for six days they were made up into standard bricklets and tiles, which were burned at various temperatures.

No.	125.	126.	127.	232.
Air-dried—				
Colour ..	Brownish yellow	Pale yellow	Dull white	Dull white
Shrinkage ..	6·0%	6·0%	6·0%	4·5%
Condition ..	Firm bond	Firm bond	Firm bond	Medium bond
Muffle heat, 950° C. ; Cone 010—				
Colour ..	Bright red	Light terra-cotta	..	..
Total shrinkage	6·0%	6·0%	..	..
Absorption ..	16·9%	16·1%	..	..
Condition ..	Medium biscuit	Medium biscuit	..	..
Muffle heat, 1010° C. ; Cone 07—				
Colour ..	Bright red	Light terra-cotta	..	..
Total shrinkage	6·0%	6·0%	..	..
Absorption ..	16·9%	15·6%	..	..
Condition ..	Medium biscuit	Medium biscuit	..	..
Muffle heat, 1050° C. ; Cone 05—				
Colour ..	Terra-cotta	Light terra-cotta	Light cream	Light cream
Total shrinkage	6·0%	6·0%	6·0%	4·5%
Absorption ..	16·7%	15·6%	17·1%	18·6%
Condition ..	Firm biscuit	Medium biscuit	Medium biscuit	Medium biscuit
Muffle heat, 1110° C. ; Cone 02—				
Colour ..	Light brown	Light buff	White	Light cream
Total shrinkage	6·0%	7·0%	6·0%	4·5%
Fire shrinkage	Nil	1·0%	Nil	Nil
Absorption ..	16·3%	13·6%	15·9%	17·6%
Condition ..	Firm biscuit	Firm biscuit	Medium biscuit	Firm biscuit
Muffle heat, 1150° C. ; Cone 1—				
Colour ..	Light brown	Light terra-cotta	White	Cream
Total shrinkage	8·0%	7·0%	6·0%	5·0%
Fire shrinkage	2·0%	1·0%	Nil	0·5%
Absorption ..	16·0%	13·6%	15·1%	16·3%
Condition ..	Firm biscuit	Firm biscuit	Firm biscuit	Firm biscuit
Muffle heat, 1210° C. ; Cone 4—				
Colour ..	Dark red	Light terra-cotta	White	Cream
Total shrinkage	8·0%	7·0%	7·0%	6·0%
Fire shrinkage	2·0%	1·0%	1·0%	1·5%
Absorption ..	15·4%	13·3%	13·5%	14·4%
Condition ..	Firm biscuit	Firm biscuit	Hard biscuit	Firm biscuit
Wind furnace, 1330° C. ; Cone 10—				
Colour ..	..	..	Grey (speckled)	Fawn (speckled)
Total shrinkage	..	..	12·0%	9·0%
Fire shrinkage	..	..	6·0%	4·5%
Absorption ..	..	..	0·8%	2·2%
Condition ..	..	..	Vitrified ; steel hard	Vitrified ; steel hard

125. This clay when burned in an oxidizing atmosphere appears to be semi-refractory. The absorption values decrease only 1.5 per cent. for a rise of temperature from 950° C. to 1,210° C. The low shrinkage suggests a siliceous clay. It is very plastic and works up readily into various shapes. The colour at the lower temperatures is a pleasant bright red. The sample is classified as a soft-burned, porous, brick or red earthenware clay.

126. This clay is similar to 125 except for its paler colour on burning.

127. This should be a useful clay if mined free from colouring matter. In an oxidizing atmosphere it burns to a white porous body, but when fired under reducing conditions it has a speckled appearance. It is highly plastic, pleasant to handle and work, burns white, and has a low shrinkage It is classified as a faience clay It should also be suitable for making modelling clay or plasticene.

232. A plastic siliceous clay, but less plastic than 127, and contains a considerable amount of grit In an oxidizing atmosphere it burns to a cream-coloured porous body, but becomes speckled under reducing conditions.

An ultimate analysis was made of 127/21.

	%
SiO_2	76·65
Al_2O_3	13·34
Fe_2O_3	1·23
FeO	0·20
MgO	0·83
CaO	0·23
Na_2O	0·28
K_2O	0·61
H_2O (at 110° C.)	1·07
H_2O (above 110° C.)	4·36
TiO_2	1·19
P_2O_5	Slight trace
SO_3	Nil
	99·99
Total fluxes	3·38

Analyst—F. F. Field.

Rational analysis :—

Quartz	57·36
Felspar, mica, &c.	9·40
Clay substance	33·54
Total	100·30

[8.4.21.]

ROCK RESEMBLING GANISTER AT TULLAMARINE, NEAR BROADMEADOWS.

By R. A. Keble.

Accompanied by Mr. Cootes, representing Ruwolt and Co. Pty. Ltd., I inspected a deposit of quartzite at Tullamarine, about 4 miles from Broadmeadows railway station by a good but hilly road, and 6 miles from Essendon railway station by a fairly good and level road.

A specimen from the vicinity, and now in the Geological Museum, was collected by the Geological Staff in 1868. An examination appeared to indicate a possible source of ganister—a highly siliceous refractory much used in the iron smelting industry. By matching the pebbles in the Moonee Ponds creek up-stream from the Broadmeadows bridge, I was able to locate the main deposit on the south bank, about 25 chains below the first outcrop of granodiorite shown on Quarter Sheet 2 S.W. It rests on the denuded surface of the Older Basalt, and protrudes from beneath the Newer Basalt, and appears to be a sandstone replaced throughout by siliceous infiltration. It breaks with a splintery fracture, and should be reduced by disintegration rather than grinding unless preheated and plunged. The percentage of silica in an average sample was determined to be 98.8 per cent. at the Geological Survey laboratory by F. Moss. An estimate of 10,000 tons as the amount within a foot of the surface may be considered a conservative one.

Quartzite more or less jointed and comparatively free from ferric staining appears *in situ* for about 100 yards up and from a few feet above to 15 feet above the bed of the creek.

The deposit is advantageously situated for quarrying.

[24.2.20.]

SAND AT LAVER'S HILL, CAPE OTWAY DISTRICT.

By W. Baragwanath.

Two leases having been marked out in the vicinity of Laver's Hill, in the Cape Otway district, for the purpose of obtaining the right to mine sand for glass-making, an inspection of the area was made to determine the nature and extent of the deposit.

Situated about half a mile south of Laver's Hill railway station, in the parish of Barwongemoong, county of Polwarth, and about 40 chains from the south-western corner of allotment 6, several gullies unite to form the head waters of the Johanna River.

On either bank of the main stream there are two large sand hummocks; these as well as several smaller hummocks, are apparently the remnants of a larger area, but the action of the numerous streams has resulted in the removal of the greater part of the formation leaving the remnants as cappings on the spurs; the various streams have now cut down to the Jurassic strata, which forms the bed-rock of the vicinity and which rises steeply to the west, north and east.

The deposit is in all probability of early Tertiary age, being formed apparently at the head of a broad valley, the northern limit of which may have been a fault; otherwise it is difficult to conceive conditions which would allow of the marginal action of the streams abutting on the northern side. At the base of the deposit is a layer of coarse gravel or bouldery wash; this is exposed on the western edge of the formation in the bed of the creek. The wash consists of pebbles of white quartz, coloured jasperoid rock, chert, siliceous conglomerate, and occasionally felspar, and resembles the sub-basaltic deposits found to the westward of Mirboo, in Gippsland. Some years ago a shaft sunk from the summit of one of the hummocks to test this wash proved, at a depth of a few inches, a body of fine sand; it is now exposed to a depth of 10 feet, but is reputed to exist to 40 feet, where the bed-rock will be found, judging by the horizontal nature of the deposit and the level of the top of the Jurassic rocks exposed in the gullies.

The two larger deposits comprise (*a*) the western area, about 8,000 square yards, and (*b*) the eastern area, 4,500 square yards. From the surface indications, I consider a fair average, allowing for overburden and slope of surface, to be about 4 yards in depth, which means a total of 50,000 cubic yards or approximately 100,000 tons. If the shaft be found to be 40 feet in depth, this estimate will be more than doubled. The smaller areas exposed appear to be much mixed with overburden—a layer of which also covers part of the eastern area—and are hardly of sufficient bulk to be worth stripping unless of greater depth than appears likely. The base of the deposit is marked in several places by springs or soaks above the level of the swampy alluvial which is found in portion of the creek beds.

The sand is of exceptionally even grain but contains visible dark grains of what appears to be mica, ilmenite, rutile and tourmaline.

The isolated position of the area handicaps the marketing of the sand, which is 350 feet below Laver's Hill railway station, and distant therefrom about half a mile, but the Geelong Glass Works Co., to whom the property belongs, proposes installing means whereby the cost of delivering at the station will be cheapened.

Bulk samples from both areas were tested in the Geological Survey laboratory and found to melt to a clear, colourless glass through which were scattered dark specks. Analyses gave—

—	819.	820.
	%	%
SiO_2	98·57	99·02
Al_2O_3	0·71	0·48
Fe_2O_3	0·07	0·03
MgO	Trace	Nil
CaO	0·32	0·30
H_2O + ...	Nil	·07
H_2O —	0·13	0·32
TiO_2	0·19	0·05
	99·99	100·27

Examined under the microscope by Mr. Mahony, the sand was found to consist of small angular grains of quartz with a small percentage of grains of tourmaline, zircon, hypersthene and iron oxides. The dark coloured minerals were evidently not dissolved when the sand was melted to a glass, hence its good colour and the occurrence of black specks in it. For commercial purposes the dark minerals would have to be separated by gravitational or other methods before the sand is used for making colourless glass. The angular character of the quartz grains suggests that the sand may have been formed under glacial conditions.

[8.10.20.]

THE CHEMICAL COMPOSITION OF SELWYNITE.

By J. C. Watson.

When testing a green mineral from Waratah for the presence of chromium, Mr. Field compared it with selwynite, supposing the latter mineral to contain at least 7.0% chromium oxide (Cr_2O_3). Even after

a carbonate fusion at high temperatures, to convert the insoluble silicate of chromium into the soluble sodium chromate, the addition of acetic acid and lead acetate gave only a faint reaction, instead of a large precipitate of lead chromate. It was considered strange that a mineral containing over 7% Cr_2O_3 should give only a faint result, even assuming that the chromium was in combination originally as the silicate.

According to *The Official Record of the Intercolonial Exhibition of Australasia* 1866-67, *Geology, Section No.* 3, by Selwyn and Ulrich, page 65; Dana's *System of Mineralogy*, page 697; and Ulrich's *Mineralogy of Victoria*, page 23, the composition of Selwynite is:—

	%	%	%	%
Silica (SiO_2)	47·15 ..	47·25 ..	48·42 ..	48·23
Alumina (Al_2O_3)	33·23 ..	35·28 ..	34·72 ..	38·16
Chromium (Cr_2O_3)	7·61 ..	7·82 ..	6·94 ..	6·14
Magnesia (MgO)	4·56 ..	2·42 ..	2·11 ..	1·21
Soda (Na_2O)	.. ..	.. ..	2·03 ..	3·12
Water (H_2O)	6·23 ..	5·67 ..	4·83 ..	2·90
Total ..	98·78 ..	98·44 ..	99·05 ..	99·76
Specific Gravity	2.53	..	..	..

The above analyses of selwynite were made by Cosmo Newbery about 60 years ago. New methods of rock analysis have been devised in recent years, new reagents, and better apparatus and equipment. Some of the old analyses must be regarded with suspicion, if not rejected. In many cases, the chemists of 50 years ago did not use platinum vessels and crucibles nor estimate such compounds as ferrous iron and titanium dioxide, nor separate the alkalis. The incompleteness of the early analyses of selwynite suggested that a thorough re-examination of the mineral was required.

Last month, a complete analysis of selwynite from Heathcote, the original type locality, was made with the following result (No. 1062).

	%
Silica (SiO_2)	39·10
Alumina (Al_2O_3)	39·02
Chromium oxide (Cr_2O_3)	0·75
Ferric oxide (Fe_2O_3)	0·43
Ferrous oxide (FeO)	0·90
Magnesia (MgO)	3·67
Lime (CaO)	0·37
Soda (Na_2O)	0·12
Potash (K_2O)	7·90
Water (combined) above 110° C. (H_2O) + ...	6·65
Water (free) at 110° C. (H_2O)—	0·56
Carbon dioxide (CO_2)	Nil
Titanium oxide (TiO_2)	0·35
Phosphorus pentoxide (P_2O_5)	Trace
Manganese oxide (MnO)	Trace
Sulphur trioxide (SO_3)	Nil
Chlorides (Cl)	Trace
Total	99·82
Specific Gravity	2·98

Analyst—F. F. Field.

In connection with the above analyses, I would draw attention to the following facts:—

(1) The early analyses of selwynite are incomplete.

(2) The low Cr_2O_3 content, 0.75%, as against Mr. Cosmo Newbery's figures, 7.61%.

(3) The absence of potash (K_2O) in Mr. Newbery's analyses. Recent analyses show 7.90%.

(4) The ratio of Al_2O_3 to SiO_2 in recent work is 1 to 1. This gives more Al_2O_3 than will combine with SiO_2 and suggests that some of the alumina is present as corundum or bauxite. Massive corundum has been found associated with selwynite at Heathcote.

[6.4.22.]

THE MINERAL COMPOSITION OF SELWYNITE.

By D. J. Mahony, M.Sc., F.G.S.

The substance selwynite was described as a new mineral species by G. H. F. Ulrich,[1] who stated that he was inclined to regard it as perhaps an altered felspathic mineral related to some of the species placed by Dana under the pinite group. He published four analyses by Cosmo Newbery and from them attempted to work out a chemical formula. In the preceding paper in this volume of Records it is shown that the old analyses are unreliable and a late analysis by F. F. Field is quoted.

Selwynite is remarkable on account of its bright green colour. It is translucent in thin flakes, massive and apparently structureless, and is traversed by thin veins of a green micaceous mineral. Its colour led some early prospectors to mistake it for copper ore, and the locality near Heathcote from which the specimens analysed by Mr. Field were obtained is still known as the Copper Mine.

For many years the substance has been regarded not as a mineral, but as a decomposed rock. The first published statement to this effect, so far as I know, was made by Professor Skeats,[2] who examined a thin slice under the misroscope. He described the bulk of the rock as consisting of a low polarizing aggregate of a micaceous or scaly mineral in which are a few grains of chromite and many crystals of altered orthorhombic pyroxene (?). It is traversed by veins of a light greenish mineral polarizing brightly.

The following calculations are based on Mr. Field's analysis, together with the examination of a thin section under the microscope and the heavy concentrates from the crushed substance. The usual method has been adopted; percentage weights have been reduced to molecular proportions, the necessary proportions then allotted to each mineral,

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[1] Intercolonial Exhibition Essays, 1866-67, No. 3. Notes on the Physical Geography, Geology and Mineralogy of Victoria; and Contributions to the Mineralogy of Victoria, Melbourne, 1870.

[2] On the evidence of the Origin, Age and Alteration of the Rocks near Heathcote, Victoria. Proc. Royal Society Victoria, 21 (n.s.) Pt. I. (1908), pp. 339 and 348.

and the molecular proportions of the minerals re-converted into percentage weights.

		Mol. Propns.	Pic.	Musc.	Ames.	Marg.	Kao.	Dias.	Leucox.	Remainder.
SiO_2 ..	39·10	6,484	..	5,154	484	132	714	..	..	..
Al_2O_3 ..	39·02	3,815	..	2,577	484	132	357	229	..	46
Cr_2O_3 ..	0·75	49	49	..	..	..	..	..	..	..
Fe_2O_3 ..	0·43	27	27	..	..	..	..	..	..	..
FeO ..	0·90	125	76	..	49	..	..	..	..	..
MgO ..	3·67	918	..	..	918	..	..	..	..	..
CaO ..	0·37	66	..	..	..	66	..	..	..	..
Na_2O ..	0·12	19	..	19	..	..	..	..	..	..
K_2O ..	7·90	840	..	840	..	..	..	..	..	..
H_2O ..	6·65	3,694	..	1,718	968	66	714	229	..	..
TiO_2 ..	0·35	44	..	..	..	..	..	..	44	..
	99·26									

Chromite (Picotite) $Fe(Cr, Fe)_2O_4$	1·73
Sericite (Muscovite) $H_2(K, Na)Al_3Si_3O_{12}$	68·49
Amesite $H_4(Mg, Fe)_2Al_2SiO_9$	13·60
Margarite $H_2CaAl_4Si_2O_{12}$	2·64
Kaolin $H_4Al_2Si_2O_9$	9·30
Diaspore AlO_2H	2·75
Leucoxene TiO_2	0·35
Excess alumina Al_2O_3	0·47
	99·33

In considering the above calculations it must be remembered that isomorphism introduces complications both in the case of the micas and chlorites, and that the chlorites especially have a wide range of variation in composition. The formulae assumed for the purposes of calculation no doubt approximate those of the mica (sericite), and the chlorite (amesite?) with which we are dealing, but they cannot be claimed as more than approximations.

Corundum was not identified as a separate mineral in the material analysed, but it is known to occur associated with selwynite. In the paper already quoted, Professor Skeats identified both fresh corundum and the same mineral replaced by secondary substances in the local diabase, the rock from which selwynite appears to have been derived.

The extremely high percentage of Al_2O_3 in the analysis suggests the presence of corundum or its decomposition products, of which the micaceous mineral margarite is a typical example. If the figures are calculated without assuming the presence of some such mineral as margarite, 1.79% Al_2O_3 remains as corundum, an amount too large to escape observation; if, however, margarite is assumed to be present in the proportion indicated by the CaO, the percentage of Al_2O_3 remaining is only 0.47.

In such a decomposed rock as selwynite the TiO_2 probably occurs as leucoxene, derived from the decomposition either of ilmenite or of titaniferous pyroxene.

The green colour is evidently due to chlorite, not to a mineral rich in chromium.

The substance is a thoroughly decomposed igneous rock.

[15.5.23.]

ANALYSIS OF AN OLIVINE NODULE FROM ABERFELDY.

By F. F. Field.

The sample was collected by W. Baragwanath, from the Newer Basalt, Aberfeldy, where it occurs as granular masses up to the size of a football. These consist of a granular mixture of bottle-green olivine (sp. gr., 3.330) and a dark mineral, probably pyroxene. The specific gravity of the sample as received is 3.404.

Analysis :—	%
Silica (SiO_2)	45·33
Alumina (Al_2O_3)	2·75
Ferric oxide (Fe_2O_3)	0·57
Ferrous oxide (FeO)	7·33
Magnesia (MgO)	41·22
Lime (CaO)	1·34
Soda (Na_2O)	Trace
Potash (K_2O)	Trace
Loss on ignition (H_2O)	1·18
Moisture (H_2O —)	0·60
Titanium (TiO_2)	Trace
Phosphate (P_2O_5)	Nil
Sulphur trioxide (SO_3)	Nil
Total	100·32

Analyst—F. F. Field.

[19.6.22.]

MUSCOVITE FROM WALWA, UPPER MURRAY DISTRICT.

By D. J. Mahony, M.Sc., F.G.S.

The mica described below has no commercial value, but is of some interest on account of its association with cassiterite at Walwa. It occurs in greisen, and is probably a secondary mineral originating from the same reactions which gave rise to the tin ore.

A sample of yellow mica from greisen collected at the Mount Alwa tin mine, near Walwa, on the Upper Murray, was analysed in the Geological Survey laboratory by Mr. F. F. Field (199/21). It is practically colourless, in thin flakes, rather brittle, and the angle between the optic axes is large. The mica, which consists of small flakes, was separated from the other constituents of the greisen by means of a heavy solution (cadmium bromotungstate), but the excess of silica in the analysis suggests that the separation was not complete. The specific gravities of quartz and the material analysed are not very different (2.66 and 2.87 respectively), and the difficulties of separation are increased by the flaky structure of the mica. As the rock is composed almost entirely of quartz and mica, all the impurities may be regarded as silica.

The result of Mr. Field's analysis is given in column 1 below.

Taking the six analyses of muscovite quoted in Iddings' *Rock Minerals*, p. 420, the silica percentage ranges from 43.67 to 46.50, the mean being 45.41, which is close to the theoretical value, 45.35. In the case of the Walwa analysis, if 45.41 per cent. of silica be considered to be chemically combined to form mica and 15.41 per cent. to be quartz impurities, the figures in the second column below represent the composition of the mica. They compare closely with the figures quoted for other muscovites, Nos. 3, 4 and 5.

—	1.	2.	3.	4.	5.	6.
	%	%	%	%	%	%
SiO_2	60·82	45·41	44·67	45·71	45·05	45·35
Al_2O_3	25·59	35·99	37·44	36·57	30·57	38·36
Fe_2O_3	1·13	1·59	0·48	1·19	1·14	Nil
FeO	0·31	0·44	0·91	1·07	1·73	Nil
MgO	Nil	Nil	0·42	0·71	0·97	Nil
CaO	0·21	0·29	0·26	0·46	..	Nil
Na_2O	0·96	1·35	1·24	0·79	2·13	Nil
K_2O	7·14	10·04	10·90	9·22	10·23	11·78
H_2O + ..	3·48	4·89	3·76	4·83	6·19	4·51
H_2O — ..	0·58	..	..	..	..	..
TiO_2	Nil	Nil	..	..	..	Nil
P_2O_5	Trace	Trace	..	..	..	Nil
MnO	Slight trace present	Slight trace present	..	..	..	Nil
Li_2O	Slight trace present	Slight trace present	..	..	..	Nil
F	..	..	0·15	0·12	1·26	Nil
	100·22	100·00	100·23	100·67	99·27	100·00
Specific gravity ..	2·87	..	2·758	..	..	..

1. Yellow mica from greisen, Walwa. Analyst, F. F. Field.
2. Same analysis recalculated after rejecting 15.41 per cent. SiO_2 for free quartz.
3. Muscovite, from muscovite granite, Omeo. A. W. Howitt, Trans. Roy. Soc. Vict., Vol. 24, Pt. 2, 1888, p. 105. Analyst, A. W. Howitt.
4. Muscovite, Bengal; quoted by Iddings.
5. Muscovite, Haddam, Conn.; quoted by Iddings.
6. Theoretical muscovite $H_2KAl_3(SiO_4)_3$.

The only other published analyses of Victorian micas are those of the biotites given below:—

—	7.	8.	9.
	%	%	%
SiO_2	39·86	38·66	35·32
Al_2O_3	11·13	19·00	13·72
Fe_2O_3	1·39	6·37	0·55
FeO	18·10	9·96	6·99
MgO	9·88	10·61	7·65
CaO	Strong trace	1·52	9·53
Na_2O	0·35	1·08	1·12
K_2O	6·73	8·58	3·93
H_2O + ...	3·20	1·85	2·59
H_2O —	0·43	..	0·67
CO_2	Nil	..	14·95
TiO_2	7·95	1·05	3·72
P_2O_5	Trace	..	Nil
MnO	·58	0·66	..
Li_2O	Strong trace	..	..
F	..	0·66	..
	99·60	100·00	100·74
Specific Gravity	3·16	2·81	..

7. Biotite from dacite, Mount Dandenong. H. C. Richards, Trans. Roy. Soc. Vict., Vol. 21 (n.s.), Pt. 2, 1909, p. 533. Analyst, H. C. Richards.
8. Biotite (Haughtonite) from quartz mica diorite, Tambo Crossing, Gippsland. A. W. Howitt, Trans. Roy. Soc. Vict., Vol. 20, 1884, p. 24. Silica estimated by difference. Analyst, A. W. Howitt.
9. Biotite altered to impure white mica, in altered dyke, Kelly's Hill mine, near Matlock. N. R. Junner, Aust. Inst. Min. and Mit., No. 39 (n.s.), 1920, p. 195. Analyst, N. R. Junner.

[7.4.23.]

ABORIGINAL PIGMENT QUARRY, NEAR MARYBOROUGH.

By A. S. Kenyon.

The following notes refer to the "sacrificial altar" or "mysterious rock" mentioned in the *Herald* newspaper of 22nd January, 1919.

In a small gully at Golden Point, about half way between Maryborough and Majorca, is a long continuous ledge of Ordovician rock projecting in most places a few feet above the ground. It bears about 5° west of north and is traceable for many chains. At one of its most

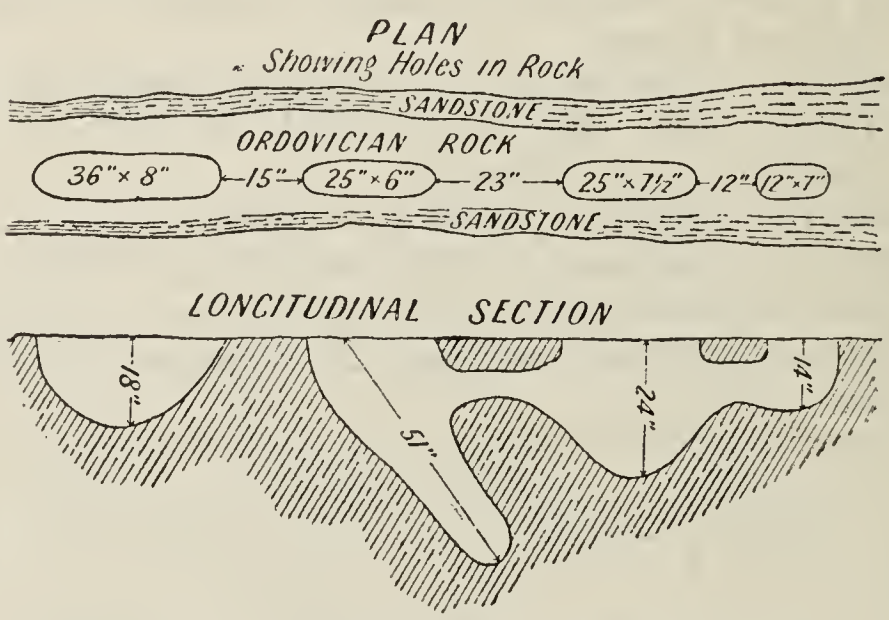

FIG. 139. Plan and section of pigment quarry.

prominent portions there is a series of four holes, in plan of an elongated elliptical shape. They vary from 6 inches to 8 inches in their widest parts, and from 12 inches to 36 inches in length. They follow exactly the strike of the rock, and are in one straight line. Immediately below the surface, they become enlarged and, in the case of three of them, unite. In one instance, one of those which unite has a separate excavation or "burrow" running from the bottom in an inclined direction to a total length from the surface of 51 inches, or measured vertically, of nearly 4 feet below the surface. All surfaces and terminations of these holes or "burrows" are rounded and bear well marked striae or scratchings. Any suggestion of natural formation may be at once banished. The only possible natural agent would be water; the form and general condition of the holes absolutely negatives such a theory. There remains then, artificial origin being admitted, the question whether these holes have been made by man or a burrowing animal. Their

age, which is apparent even to a superficial examiner, precludes the rabbit, while their size is against their being made by wombats. The soft rock which has been removed in the process of forming these holes, judging from that remaining on the sides and bottoms, yields an ochre of a rich yellow colour. From the general appearance of the excavations and from the material excavated, there can be no doubt that the objective was pigment, and the excavators were the aboriginals. Pigment, generally red, white and black, more rarely yellow, was largely used by them and highly prized, great hardships being endured in journeys through scrub and arid areas to obtain it when within their own boundaries, and high prices in commodities in exchange being given when there was none accessible to them. At any of their old camps, where there has been exposure of the remains by sand drifting or other causes, pigment in various forms is freely found.

[14.3.19.]

REPORTS ON GRAPTOLITES.

By R. A. Keble.

Cranbourne.

Spec. No. 18616.

Allot. 28, Parish of Langwarrin; from outcrop of yellow shale in gully on south side of Woodlands homestead; collected by R. A. Keble.

Climacograptus sp.

? Climacograptus sp.

Age, probably Upper Ordovician.

The discovery of graptolites at Cranbourne, probably of Upper Ordovician age, is of interest, as it suggests the northern extension of the Schanck Peninsula Ordovician belt.

Some years ago Professor Skeats located Upper Ordovician slates near Mooroduc, about 8 miles south-west of the present locality.

A more representative collection could be made with an hour or two at the collector's disposal; in the present instance the fossiliferous beds were not located until the end of the day.

Lithologically the fossiliferous beds resemble Silurian shales.

[21.1.19.]

Howe's Creek.

Locality.—Howe's Creek Phosphate Mine; collected by A. M. Howitt.

Nos. 1A to 27A from a trench, Allotment 113A, Parish of Loyola. 30 feet from main shaft at a bearing S. 30° E. The containing rock is blue normal slate stained with ferric oxide.

Monograptus leptotheca, Lap.
M. McCoyi, Lap.
M. cf. cutellus, Torn.
M. cf. proteus, Barrande.
M. (Monoclimacis) sp. indet.
M. spp. nov.
Climacograptus sp.
Diplograptus sp.
Retiograptus sp.

The slabs are crowded with Monograptus spp. As no zonal work has ever been attempted in connexion with our Silurian graptolites, a comparison with those of localities outside Australia is the only method

of arriving at a conclusion as to their position in Victoran Silurian rocks. In the British Isles, *Monograptus leptotheca* belongs to the Llandovery and Birkhill shales, *M. McCoyi to* the Tarannon shales, *M. cutellus* to the Lower Wenlock shales (basal beds) and *M. proteus* to the Llandovery and Tarannon shales. *M. Monoclimacis* is a primitive monograptid form which partakes of the characteristics of *Climacograptus*—a typical Upper Ordovician form—and *Monograptus* which is, of course, typically developed in the Silurian; it is usual to find *Monoclimacis* in the lower beds of the Silurian. Apart from the above forms there are others which are apparently new and will require considerable examination to establish their affinities. The available evidence is conclusive, and precludes the possibility of the beds being other than Lower Silurian (the Melbournian beds of Victoria or the Llandovery beds of Britain). As regards Victorian graptolites, the association is new, and is an interesting addition to our scanty knowledge of Silurian graptolites.

Nos. 1B to 7B, from an outcrop in a trench, Allotment 133A, Parish of Loyola, 100 feet north-west from main shaft; an altered, partly silicified slate.

Graptolitoidea sp. indet.
Crustacea.

There is no palæontological evidence to indicate the age of these slates.

[31.5.18.]

BLACKWOOD.

18336-18360. On portion of Blackwood-road, bearing N. 38° 6′ W., north of town of Greendale. Collected by W. H. Ferguson

Didymograptus aureus, T. S. Hall	18341
D. sp.	18336
Tetragraptus fruticosus (4 br), J. Hall ...	18336, 18351
T. cf. fruticosus (4 br), J. Hall	18352
T. fruticosus (3 br), J. Hall	18352
T. fruticosus (2 br), J. Hall	18348, 18360
T. fruticosus, J. Hall	18348, 18360
T. bryonoides; J. Hall	18336
T. cf. quadribrachiatus, J. Hall	18358
T. cf. acclinans, Keble	18345
Dichograptus octobrachiatus, J. Hall ...	18345, 18358
Goniograptus laxus, T. S. Hall	18351

Horizon—Lower Ordovician, Bendigo zone, B3 sub-zone. *D. aureus* and *T. cf. acclinans* indicate fairly old beds in the sub-zone.

18361-18372. Near Lederderg River, between the river and the headwaters of Rum Creek, parish of Blackwood. Collected by W. H. Ferguson.

Didymograptus aureus, T. S. Hall	18362, 18368 (reverse of 18362)
D. latens, T. S. Hall	18373
D. extensus, J. Hall	18370, 18373 18374, 18379
D. sp.	18370, 18373 18376, 18379
Tetragraptus fruticosus (4 br), J. Hall ...	18361, 18363 18367, 18369

T. fruticosus, J. Hall	... 18365
T. pendens, Elles	... 18372
T. decipiens, T. S. Hall	... 18362, 18368 (reverse of 18362)
T. harti, T. S. Hall	... 18373
T. serra, Brongniart	... 18373, 18374
Phyllograptus augustifolius, J. Hall	... 18374, 18376, 18378

Horizon—Lower Ordovician, Bendigo zone, at the base of sub-zone B3. If further search revealed the presence of *T. approximatus* Nicholson, the association would be typical of B4.

Remarks.—Both associations are about the same horizon as the surface beds in the vicinity of the Victoria Quartz mine, Bendigo.

[13.1.20.]

TERTIARY FOSSILS FROM BORE CORES, PORT FAIRY.

By F. Chapman, A.L.S.

The specimens were obtained from a bore sunk to a depth of 987 ft. by the Mines Department in search of water at the Glaxo factory, Port Fairy.

Dep. No.	Depth.	Details.
	Ft.	
19645 ..	110	Pale grey marl. Cast of a bivalve, indet. : also a polyzoan (*Adeona* sp.)
19647 ..	130	Whitish, hard marl. No fossils visible
19648 ..	140	Pale grey marl, with a considerable amount of glauconite
19649 ..	150	Whitish marl, excessively hard and fine-grained : a fair amount of micaceous fragments present
19650 ..	160	Hard, white marl. Fragments of polyzoa and occasional foraminifera (*Pulvinulina*, &c.). Also worm burrows
19651 ..	170	Fine-grained grey marl with foraminifera and stem-like replacements in iron pyrites
19652 ..	180	Hard, whitish marl, with micaceous flakes
19653 ..	190	Hard, whitish marl, with micaceous flakes
19654 ..	200	Hard, whitish marl, with a few foraminifera. Pyritous stems in places
19655 ..	210	Hard, grey marl, with glauconite and foraminifera
19656 ..	220	Hard, grey marl : with filamentous seaweed-like pyritous stains
19657 ..	230	Hard, grey marl : with (?) bivalve shell-remains
19658 ..	240	Pale grey marl : with worm tubes (*Ditrupa*) and foraminifera
19659 ..	250	Hard, grey marl. The fractured surface of the bore-core shows a fine frond-like zoarium of *Adeona grisea*. Pyritous seaweed-like markings present
19660 ..	260	Grey marl : with tunnels of (?) burrowing mollusca
19661 ..	270	Grey marl : with shell fragments and pyritous stains
19662 ..	280	Pale grey marl : with badly preserved polyzoa (*Adeona*)
19663 ..	290	Grey marl : with polyzoa
19664 ..	300	Grey marl : with polyzoa
19665 ..	310	Missing
19666 ..	320	Grey marl, with polyzoa
19667 ..	330	Grey marl, with ostracoda, foraminifera, and polyzoa
19668 ..	340	Grey marl, with foraminifera (*Miliolina vulgaris* and *Truncatulina ungeriana*). Also remains of polyzoa stained with pyrites
19669 ..	350	Hard, stony marl, with cast of a bivalved shell partly filled with dog's tooth calcite. Much glauconite present
19671 ..	370	Grey marls, with casts of gasteropod shells : also polyzoa and foraminifera

TERTIARY FOSSILS FROM BORE CORES, PORT FAIRY—*continued.*

Dep. No.	Depth.	Details.
19672 ..	380	Moulds and casts of bivalve shells ((?) *Pinna*, (?) *Tellina*). Also polyzoa (*Adeona obliqua*)
19673 ..	390	Grey marls, with pyritous stains
19674 ..	400	Hard, concretionary marl, with doubtful polyzoa
19675 ..	410	Hard, grey marlstone
19676 ..	420	Fine-grained grey marl, with remains of polyzoa
19678 ..	440	Hard, grey marl
19679 ..	450	Hard, grey marl, with remains of polyzoa
19679 ..	450	Hard, grey marl, with remains of polyzoa (*Adeona obliqua*, &c.) and foraminifera (*Miliolina* and *Truncatulina*)
19680 ..	460	Hard, white marl, with remains of polyzoa
19681 ..	470	Hard, white marl, with numerous foraminifera, indet.
19682 ..	480	Hard, white marl, with polyzoa (*Adeona*)
19683 ..	490	Grey marl, with polyzoa
19684 ..	500	Whitish marl with polyzoa (*Macropora* sp.). Strings of pyritous stains and some gypsum
19685 ..	510	Hard, white marl, with foraminifera
19686 ..	520	Hard, white marl, with foraminifera (*Miliolina vulgaris*)
19687 ..	530	Hard, grey marl, with abundant polyzoa, chiefly *Adeona* sp.
19688 ..	540	Whitish marl, with polyzoa, indet.
19689 ..	550	Hard, white marl, with polyzoa
19690 ..	560	Hard, subcrystalline limestone, with polyzoa and foraminifera
19691 ..	570	Hard, grey marl, with polyzoa
19692 ..	580	Hard, grey marl, with abundant remains of *Adeona obliqua*
19693 ..	590	Grey marl, with polyzoa (*Adeona obliqua*), and foraminifera (*Biloculina* sp.)
19694 ..	600	Whitish marl, with casts of shells and remains of foraminifera
19695 ..	610	Grey marl, with abundant zoaria of *Adeona obliqua*
19696 ..	620	Hard, grey limestone, with polyzoal remains
19697 ..	630	Hard, grey limestone, with veins of gypsum
19698 ..	640	Grey marl. Polyzoa numerous (*Hornera* and *Crisia*)
19699 ..	650	Grey marl, with polyzoa (*Crisia*, &c.). Also echinoid spines
19700 ..	660	Hard, white marly limestone
19701 ..	670	Hard, grey marl, with polyzoa (*Adeona* sp.)
19702 ..	680	Hard, grey marl. Remains of polyzoa and foraminifera, indet.
19703 ..	690	Soft dark grey marl, full of polyzoal fragments
19704 ..	700	Hard, sandy marl. Polyzoa (*Adeona obliqua*)
19705 ..	710	Grey marl, with numerous minute foraminifera
19706 ..	720	Grey marl, with polyzoa (*Adeona* cf. *cellulosa*, McGill)
19707 ..	730	Hard, grey marl, with polyzoa and bivalve (*Nuculana apiculata*)
19708 ..	740	Hard, grey marl, with foraminifera, indet.
19709 ..	750	Grey marl, with polyzoa, and cast of gasteropod, indet.
19710 ..	760	Hard, grey marl, with polyzoa (*Adeona* cf. *obliqua*) and worm-like markings
19711 ..	770	Grey marl, with polyzoa (*Adeona cellulosa*)
19712 ..	780	Grey marl, with polyzoa
19713 ..	790	Soft grey marl, with polyzoa
19626 ..	800	Grey marl with polyzoa. (*Adeona* cf. *grisea* and *A. obliqua*)
19627 ..	810	Grey marl, with polyzoa
19628 ..	820	Grey marl, with polyzoa
19629 ..	830	Grey sandy marl, with polyzoa.
19630 ..	840	Grey marl, with polyzoa (cf. *Lunulites*)
19631 ..	850	Hard grey marl, with polyzoa
19632 ..	860	Hard, grey concretionary marl with polyzoa (*Adeona*) and foraminifera (*Miliolina vulgaris*)
19633 ..	870	Grey marl, wih polyzoa
19634 ..	880	Grey marl, with polyzoa (*Adeona grisea*)
19635 ..	890	Hard sandy marl, with polyzoa (*Adeona*)
19636 ..	900	Grey marls, with *Nuculana* sp. gasteropod casts and polyzoa (*Adeona grisea*)

TERTIARY FOSSILS FROM BORE CORES, PORT FAIRY—*continued*.

Dep. No.	Depth.	Details.
19637 ..	910	Grey marl, with casts of bivalves, gasteropods, and polyzoa (*Adeona grisea* and *A. obliqua*)
19638 ..	920	Soft marl, with polyzoa and molluscan shells (*Natica* cf. *hamiltonensis*)
19639 ..	930	Soft grey marl, with polyzoa (*Porina gracilis*, M. Edw. var. *dieffenbachiana*, Stolicka and *Adeona grisea*). Also small gasteropods, indet.
19640 ..	940	Grey marl, with polyzoa (*Adeona grisea*) : mollusca (*Nuculana woodsi*) : and foraminifera (*Miliolina vulgaris* and *Polymorphina elegantissima*)
19641 ..	960	Hard grey marl, with polyzoa (*Adeona grisea*)
19642 ..	970	Grey marl, with shell fragments and polyzoa (*Adeona*)

LIST OF FOSSILS.

	Depth in Feet..
Foraminifera—	
Biloculina sp.	590
Miliolina sp.	450
Miliolina vulgaris, d'Orb. sp.	340, 520, 860, 940
Polymorphina elegantissima, P. and J. ..	940
Truncatulina sp.	450
Truncatulina ungeriana, d'Orb. sp. ..	340
Pulvinulina sp.	160
Worms—	
Ditrupa sp.	240
Polyzoa—	
Adeona sp.	110, 280, 480, 530, 670, 860, 890, 970
Adeona cf. *cellulosa*, McGill	720, 770
Adeona cf. *griesa*, McGill	800
Adeona grisea, McGill	250, 880, 900, 910, 930, 960
Adeona cf. *obliqua*, McGill	760
Adeona obliqua, McGill	380, 450, 580, 590, 610, 700, 800, 910
Crisia sp.	640, 650
Hornera sp.	640
cf. *Lunulites* sp.	840
Macropora sp.	500
Porina gracilis, M. Edw. var. *dieffenbachiana*, Stol.	930
Pelecypoda—	
Nuculana sp.	900
Nuculana apiculata, Tate	730
Nuculana woodsi, Tate	940
(?) *Pinna* sp.	380
(?) *Tellina* sp.	380
Gasteropoda—	
Gasteropoda, indet.	940
Natica cf. *hamiltonensis*, Tate	920

AGE OF THE STRATA.

The lithological condition of the bore-cores varies from marly clays, through marls and marlstone to almost pure limestone. From the abundance of the polyzoa in the majority of the cores they closely resemble the polyzoal series of the Mallee. None of the rocks seem to have been laid down in shallow water, and the evidence points to depths varying from 50 to 500 fathoms. The mollusca present are unrestricted as to their occurrence in either Balcombian or Janjukian strata, but the discovery of *Ditrupa*, together with the abundance of polyzoa, decides the balance of evidence in favour of a Janjukian or Miocene age.

[27.7.22.]

FOSSIL RESINS (RETINITE) FROM YALLOURN, ALLENDALE, AND LAL LAL.

By J. C. Watson.

The samples examined are all of Tertiary age. Those from Yallourn and Lal Lal were found in the brown coal or lignite deposits. The Allendale specimen came from the deep lead, where part of the formation consists of black clays in which logs still retaining their woody structure are occasionally found some 300 feet below the surface and overlain by three flows of basalt.

No. 439/22. Resin from brown coal, open cut, State Brown Coal Mine, Yallourn.

No. 681/22. Clear resin with embedded leaves, deep lead, Allendale.

No. 682/22. Powdery resin with lignite, Lal Lal Brown Coal Mine.

PHYSICAL PROPERTIES.

——	439.	681.	682.
Colour	Light brown	Colourless to pale yellow	White
Hardness	2	2	Earthy
Lustre	Sub-vitreous	Vitreous	Resinous
Powder	White	White	White
Transparency	Translucent	Semi-translucent	Opaque
Fracture	Conchoidal	..	..
Melting point	170° C.	130° C.	340° C. (approx)
PROXIMATE ANALYSES.			
Moisture at 110° C.	0·75	2·60	5·26
Vol. hydrocarbons	98·95	96·90	88·39
Fixed carbon	0·25	0·40	4·47
Ash	0·05	0·10	1·88
	100·00	100·00	100·00
ULTIMATE ANALYSES.			
Carbon	73·18	67·11	65·90
Hydrogen	8·74	7·89	8·04
Oxygen	17·94	24·79	24·07
Ash	0·14	0·21	1·99
	100·00	100·00	100·00
EMPIRICAL FORMULAE.			
	$C_{12}H_{17}O_2$	$C_{11}H_{16}O_3$	$C_{11}H_{16}O_3$
SOLUBILITY (COLD).			
Absolute alcohol	2·2	96·7	12·8
Sulphuric ether	42·4	61·2	..
Benzol	7·6	30·6	..
Chloroform	29·6	42·7	..
Carbon bisulphide	21·4	28·4	..
Turpentine	44·4	57·0	..
LOW TEMPERATURE DISTILLATION (500° C. APPROX.).			
Oil yield	84%	85%	..
Gallons per ton	188	194	..
Specific gravity	0·986	0·980	..

The resins burn with a long, smoky flame, producing an aromatic odour. They give no coke. The Lal Lal specimen was too small for distillation test or solubility except in alcohol. The oil from the two samples distilled is thick, heavy, brown and aromatic in each case.

No. 439 when mixed with linseed oil and thinners produces a dark reddish-brown oil-varnish which dries to a smooth, bright elastic surface. An article varnished with this mixture showed no signs of "crazing" after exposure out-of-doors for eight weeks.

If procurable in sufficiently large quantities, the resins should have a value for the manufacture of oil varnishes and resin oil.

[23.8.22.]

NOTES ON THE BROWN COAL FROM MORWELL, SOUTH GIPPSLAND.*

By Frederick Chapman, A.L.S., &c., Palæontologist to the National Museum.

Sample of Typical Brown Coal.

General Characters.—This coal breaks with a rough conchoidal fracture, and tends to develop cracks on exposure to air. It is of a deep chocolate colour, reminding one of a dark lignite. The fine-grained surface is here and there relieved by small particles, probably of the nature of seeds, some woody elliptical bodies which seem to be referable to valves of fruit cones, and various fragments of woody tissue, in which the hard sclerenchymatous cell-structure is easily seen. When cut with a knife the coal glistens as in a highly-altered lignite.

Microscopic Characters.—Several micro-slides of this rather refractory substance were attempted. The sections were sufficient to show that probably half of the material is derived from ordinary terrestrial vegetation, whilst the remainder seems to be a hydro-carbonaceous mud similar to that of the sapropelic coals of older formations, but without the distinct micro-cellular structure. The coal was chemically treated, to dissolve away the ulmic acid, and, when dried, the material readily broke down into a fine powder. Under a high magnification this treated material is seen to be full of granular bodies, generally spherical. Most of them have a dark centre, sometimes double, and these minute bodies also occur in the tissues of plant remains in the sections of the coal. They average a diameter of 2.6μ, and generally resemble the micrococci described by Renault, who found them in the pith of a Carboniferous plant *Calamites*. Other and larger bodies present in the coal may be referable to seeds and pollen grains, the former showing the coarser cellular structure of the tests, the latter being spherical, with resinous texture and a thin investment.

The Probable Formation of the Coal.—These deposits appear to have been derived from huge forests in the higher mountainous regions of Eastern Victoria, the material having accumulated in large and comparatively shallow swamps not much above sea-level. From their great thickness it may be assumed either that the coal area was situated on a continuously sinking foundation, or that the material was gathered

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* Reprinted from Geol. Surv. Vict. Bulletin No. 45. The Brown Coal Deposits of Victoria.

in a large degraded area of the slope of the ranges, after which it was lowered to several hundred feet below sea-level. The theory of a contemporaneous warping of the crust beneath the coal area, however, appears, in the writer's view, to best explain the physiographic and stratigraphic evidence.

Partially altered plant remains average perhaps 50 per cent. of the coal, and chiefly consist of wood and woody tissue or other vegetable structures in various states of decay. In this coal there are also woody valves of fruit cones, closely resembling those of *Callitris*. The remainder of the coal, judging from a close microscopic study, appears to be of the nature of a decayed hydrocarbonaceous mud, with a good deal of resinous matter. Partially decayed vegetable tissue can be distinguished in this matrix, portions of which appear to have been attacked by decomposing bacteria (micrococci, &c.), after the manner of the present-day destructive agent, *Bacillus amylobacter*, described by Professor Van Tieghem.

Thus, the coal seems to be partly of swamp origin, the material being augmented by drifted wood, cone-fruits, and other plant remains. Judging from the comparative purity of the coal, that is, freedom from sand, and other terrigenous débris, it was not brought from a very great distance.

Nature of the Woody Tissue in the Morwell Coal.—From the brown coal of Morwell may be picked out numerous pieces of more or less well-preserved tree stems and branches. Some of the stems measure over 10 cmm. across. (See Pl. LIX., Fig. a.) Under a low power this wood seems very promising for microscopic examination, but when sliced and highly magnified it is somewhat disappointing, for, although the structure may be there, it is masked by the ulmic acid deposited in the tissues. Its condition is such that it is midway between lignite and jet, and takes a high polish; but the material is not permanent, as it is liable to shrink and crack. From the examination of many sections from various specimens of wood enclosed in the brown coal, the structure is invariably of a gymnospermous character, and, further, belongs to the *Cupressinoxylon* type of coniferous wood. It closely resembles *Callitris* in general details, as in the oblique central mark of the bordered and pitted ducts of the rays, and in the minute structure of the cell-wall. Some of the pitted cells measure 14 μ in diameter, which is the average of those in *Callitris cupressiformis*. On the other hand, the resiniferous cells in the wood of the brown coal are only half the diameter of the *Callitris* cited, and are more akin to a type like *Cryptomeria*. One example of woody stem found in this coal had the bark attached, and in both macroscopic and microscopic characters resembled the Mountain Cypress-Pine (*Callitris cupressiformis*).

A sample of fossil wood (lignite) from Bore No. 63, parish of Narracan, depth 160 feet, is *Casuarina* sp. (nearest *C. stricta*.).

Summary of Conclusions.

The Morwell coal is apparently formed of many types of vegetation, including a considerable proportion of tree stems of coniferous affinities which are closely allied to, if not identical with, *Callitris*. This material, together with the half-decayed leaves, spores and seed-vessels of the undergrowth, was probably drifted into large swampy catchment areas not very far removed from its original source. This accumulated mass of vegetation must have become consolidated under peculiarly

favorable circumstances, its condition supporting the view of a slowly-subsiding area abutting against the afforested hinterland, the latter being bounded by a line of crustal weakness or warping, giving rise to enormous debouchures of the rivers which then formed broad valley swamps.

In the absence of palæontological evidence other than the plant remains here mentioned it is impossible, from that point of view, to assign any particular age to this deposit beyond that of Tertiary. The physiographic evidence, however, points to the fact that during the formation of this comparatively extensive deposit there must have been large and important diastrophic movements of the coastal region, which leads one to infer the probable age as Miocene or thereabout. In the Morwell area the remnants of older basaltic streams (of Miocene age) filled up and overflowed valleys which had been graded to base level, and these, or later contiguous ones, formed the channels along which were floated enormous rafts of vegetation similar to that described by H. O. Forbes[1] as occurring in the flooded country of the Rawas River, in Sumatra.

"The whole surface of the water was covered, absolutely in a close sheet, with petals, fruits, and leaves, of innumerable species. In placid corners sometimes I noted a collected mass nearly half a foot deep, among which, on examination, I could scarcely find a leaf that was perfect, or that remained attached to its rightful neighbour, so that were they to become embedded in some soft, muddy spot, and in after ages to re-appear in a fossil form, they would afford a few difficult puzzles to the palæontologist, both to separate and to put together."

ON SOME SEED-LIKE BODIES IN THE MORWELL BROWN COAL.

By Fredk. Chapman, A.L.S., Palæontologist, National Museum.

(Hon. Palæontologist to the Geological Survey.)

Occurrence.—Four specimens from the Morwell open cut have been examined, collected by Messrs. A. M. Howitt (two samples), R. A. Keble, and F. L. Porter. They are ovoid to subspherical, and when found, by breaking the coal, they dropped from a smooth-walled cavity, wherein there was evidently a slight shrinkage space between the nucleus and the wall.

Description.—The specimens have a smooth surface, except where fissured by a minute tesseræ of cracks. Where the surface is broken away there is generally a trace of cellular structure. A contused appearance is seen on parts of the surface, and sometimes a few scattered prominences. Two examples (Howitt and Porter coll.) are subspherical or roundly ovoid, and of even contour, except for a slight scar towards one end and side.

Another specimen is roundly ovoid, with one end somewhat tapering, and the surface much cracked (Keble coll.); this also shows a scar towards the narrow end.

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[1] A Naturalist's Wanderings in the Eastern Archipelago. London, 1885, p. 254.

The fourth example (Howitt coll.) is the most interesting, since, although apparently related to the others in size, general form, surface and colour, shows more definitely preserved characters of the external surface. This specimen, whilst being generally ovoid, is also subtrigonally flattened, and bears at each end an area differentiated by colour, being paler, that at one end corresponding to the base in cycadaceous seeds, in being slightly raised above the general surface. This latter feature is a character of seeds like *Macrozamia*. The broad end, comparable with the base in the cycad seed, shows indications of several pitted channels which, in the living forms, are due to the entrance of vascular strands. The colour of these fossils varies from pale brown to deep umber, whilst the surface is often mottled in patches.

Measurements of Two Specimens.—A. (Howitt coll.), 15.5 mm. in length; 11.5 mm. in greatest breadth. B. (Keble coll.), 16 mm. in length; 13 mm. in greatest breadth.

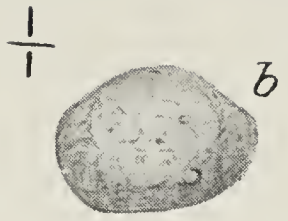
Summary of Evidence.—These bodies cannot have originated as rolled pellets, since they are not uniformly rounded or ellipsoidal; moreover, the surface shows local irregularities, as swellings and depressions. The internal structure of a fractured specimen presents a sub-crystalline appearance, rudely spherulitic and fibrous, resembling similar structures often found replacing organic tissue in fossil wood and other plant remains.

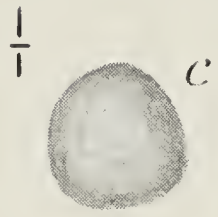
The evidence against the idea of their being infilled crypts in wood is quite conclusive from their occurrence, not in the abundant fossil wood remains, but in the carbonaceous matrix consisting of the hardened mud with plant tissues, such as woody fragments and minute seeds.

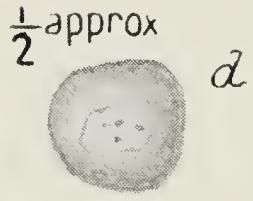
The balance of evidence points to a seed origin, and strong support is adduced in favour of a cycadaceous relationship. One of the specimens is in fact a miniature facsimile of the seed of *Macrozamia perowskiana* Miquel, the Giant Fern Palm of New South Wales and Queensland, examples of which I lately collected on the New South Wales coast at Narrabeen; although it measures only one-sixth to one-half the length of the living species. The remaining specimens are more regularly ovoid in form, but otherwise show the same characters of surface, with occasional irregularities. From the rotundity of these latter specimens it was at first thought probable that they might be allied to seeds of the *Palmaceæ*. Many of these were examined, the seeds of *Livistona australis* Martius (Australian Cabbage Palm), and *Kentia mooreana*. F. von Mueller (Moore's Palm), affording the nearest comparison. Both of these palms have more spherical seeds, the former having a distinct point of attachment, which would be likely to persist in a fossil; the latter is subpherical, with a rough test, and has a keeled inner layer.

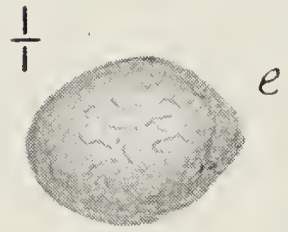
Comparing the fossils with cycadaceous seeds, the cavity in the brown coal matrix, with a smooth lining, would suggest the original layer of the sarcotesta, whilst the nucleus would represent the sclerotesta and its contents.

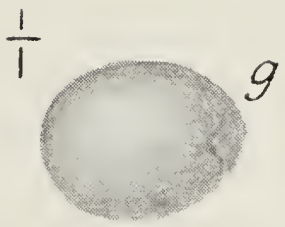
Judging from the superficial characters, and in the absence of internal structure, these fossils may be provisionally referred to as doubtful cycadaceous seeds, and if their relationship to *Macrozamia* or an allied genus is upheld by further additional evidence, an interesting











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PORTION OF A TREE TRUNK AND SEED-LIKE BODIES FROM BROWN COAL, MORWELL OPEN CUT.

factor will be added to our knowledge of the Middle Tertiary Flora of South-Eastern Australia[1]

My thanks are due to the Curator of the Botanic Gardens (Mr. J. C. Cronin) and to his assistant (Mr. W. R. A. Baker) for facilities in examining the valuable collection of seeds under their care.

EXPLANATION OF PLATE LIX.

Fig. *a*.—Portion of tree-trunk (probably *Callitris*), showing scar where branch was attached. From Brown Coal Deposits, Morwell open cut. (F. C. coll.) Reduced one-fifth.

Fig. *b*.—(?) Cycadaceous seed, showing irregularly swollen and fissured surface (Howitt coll.).

Fig. *c*.—Basal view of the same, showing scar,

Fig. *d*.—Basal view of seed of *Macrozamia perowskiana* Miquel, showing absciss-layer and entrances of vascular strands, for comparison with Fig. *a*. Reduced about one-half.

Fig. *e*.—Another fossil specimen showing a more ovoid outline and basal marking. (Keble coll.).

Fig. *f*.—A fractured specimen (Howitt coll.), showing fibro-spherulitic structure, due probably to mineralization.

Fig. *g*.—A rather regularly ovoid example, showing traces of scar at basal end. (Porter coll.).

Fig. *h*.—Basal end of same, showing appearances which may correspond to the absciss-layer and entrances of vascular strands.

All figures on this plate, excepting *a* and *d*, are of natural size.

TERTIARY FOSSIL FRUITS FROM DEEP LEAD, FOSTER, SOUTH GIPPSLAND.

By H. Deane, M.A., M.Inst.C.E., F.L.S., &c.

The fossil fruits described below were collected by Mr. W. Ferguson from the spoil heaps at an abandoned shaft in the Foster racecourse reserve. The shaft had been sunk to work the Stockyard Creek lead for gold and the depth to bed-rock was 45 feet. Mr. Ferguson considers that in all probability the fossils came from the bottom of the alluvial just above bed-rock.

The specimens are numbered 324 to 332 and 338 to 341 inclusive.

I have carefully compared the above with the illustrations contained in *Observations of New Vegetable Fossils of the Auriferous Drifts*, by the late Baron Ferdinand von Mueller, First and Second Decades, 1874 and 1883, and I have several times visited the Carpological Museum at the Melbourne Botanic Gardens and have there compared the fossils with fruits of living species of trees and sometimes with living specimens of apparently allied forms.

The number of species at present collected from the Foster beds is small compared with those handed over to the late Baron von Mueller and described in the above work. The individual fruits from Foster are sufficiently like some of those described and figured in that work to admit of their being recognized as closely related, but there are some slight differences to which attention must be called.

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[1] NOTE, 28th May, 1921.—Since the above was written we have received for the National Museum collection several additional examples of seed-like, resinous bodies, which do not in all cases conform to those above described. Some of them are much larger, round, and more or less oblate. In regard to the generally ovate and seed-like forms, the balance of evidence is still in favour of an organic origin, since, if they were purely radially structured concretions they should show a proportion of spherical forms.

On investigation I find that some of the fossil fruits both from Haddon and Foster closely resemble fruits of existing trees, so that it would be incorrect to assume that since the deposition of these leads there has been a great break in the evolution of the flora and that the botanical groups then existing have now completely died out. Some types like *Spondylostrobus* may have become extinct, but that is by no means the general rule.

Types of the Foster fruits have been set up and very beautifully photographed by Mr. Woolcott, the photographer of the Government Printer's Department, Melbourne, and I feel personally indebted to him for the trouble taken.

Specimen No. 324—Fruit about $1\frac{1}{4}$ inch diameter, four valved rhomboidal in horizontal section. One seed has been developed about $\frac{3}{4}$ inch long. Inside, the valves are lined with spongy, cellular structure, probably pulpy originally. Surface of valves slightly roughened or muricate, perhaps from shrinking during drying. See Plate LX., Figs. 1, 2 and 3.

No. 325.—Fruit similar to the above, slightly smaller, but five-valved. Two seeds seem to have been developed but have been lost.

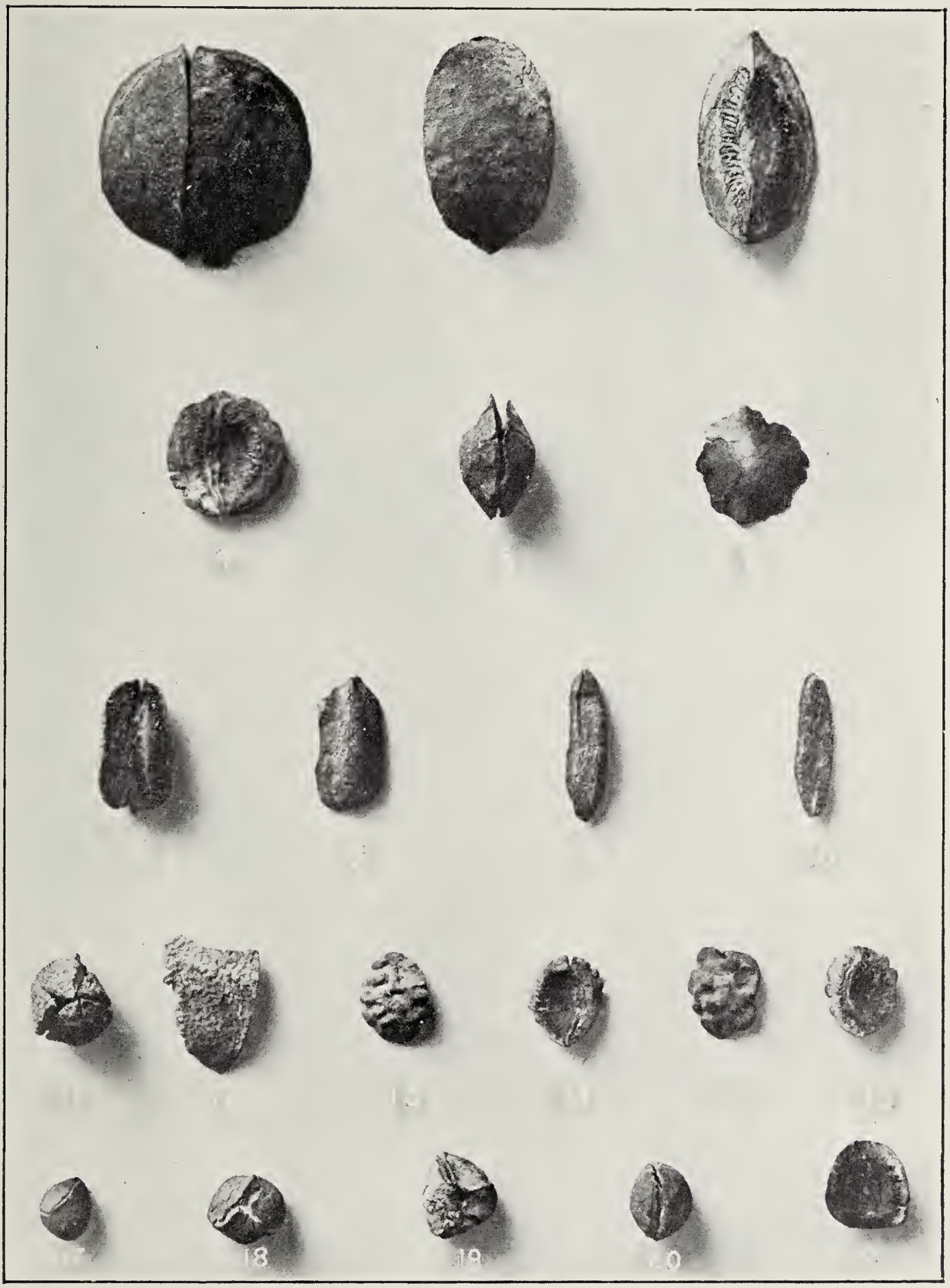
No. 326.—Fruit similar to the above, four-valved. No seeds developed.

Specimens No. 324, 325 and 326 probably represent one species in spite of the variation in the number of the valves. The structure of the fruits seems to be similar to that of *Penteune Clarkei*, F. v. M., figured in Plate VII. of Baron von Mueller's work; they are, however, much more regular in shape and only one out of three is five-valved. According to name and description there should be five valves.

The general appearance of these fruits, with their regularity of shape, is remarkably like that of *Owenia venosa* and allied species. In these species there is inside the hard valves a succulent sarcocarp surrounding the seeds, and it is to be observed that the interiors of the fossil fruits were evidently of a soft spongy nature which on the ripening of the fruit would fall away and decay, leaving the thin, hard valves outside intact.

Specimens of *Owenia venosa* in the Carpological Museum shown to me by Mr. Baker are very like these. Those that had seeds developed possessed thinner valves; evidently their succulent surroundings wanted more room.

In Mr. St. John's company on the 2nd of September last year I picked up in the gardens some old fruits of *O. venosa* which had been resting on the ground a long time. One had been fully developed and the seeds and pulp were gone. Others were partially abortive. One which had not opened contained a seed surrounded by dried pulp. The fruits picked up under the tree of *Owenia venosa* in the Botanic Gardens are smaller than the fruits from Foster, possibly because the Melbourne climate at the present time is colder than that of the country in former ages. In *Bentham Fl. Aust.*, Vol. I., p. 386, the size of the fruits of *O. cerasifera* is given as 1 to $1\frac{1}{2}$ inch in diameter; that of *O. reticulata* as $1\frac{1}{2}$ inch. They flourish to-day in a more northerly climate. The Natural Order *Meliaceae* has no representatives to-day in Victoria.



TERTIARY FOSSIL FRUITS, FOSTER.

Specimens 327 and 338 I have identified as similar to the Baron's *Concotheca turgida*, illustrated in Plate X. of his work. The shape of the fruits is somewhat variable. The alliance seems to me to be with *Sapindaceae*. They are shown here in Plate 69, Figs. 11, 17, 18, 19, 20 and 21.

Specimens Nos. 328 and 340 correspond to the Baron's *Phymatocaryon bivalve* (see his Plate XV.). They are illustrated in the attached Plate under Figs. 4, 5 and 6.

Specimens Nos. 331 and 332 seem to me to correspond with the Baron's *Rhytidotheca pleioclinis* figured in his Plate VI. This name he changed in the Second Decade of his work to *Pleioclinis Shepherdi* (see page 20) reserving the generic name *Rhytidotheca* for *Rhytidotheca Lynchii* only. In the Plate, they are shown under Figs. 7 and 8.

Specimen No. 329 I have referred to *Rhytidotheca Lynchii*, F. v. M., figured in the Baron's Plate IV. It has the same structure and general character, although much smaller. The size of the fruit is evidently very variable. In the adjoining plate it is shown under Figs. 9 and 10. The fruits, which seem to have lost their terminal points, are otherwise remarkably like those of *Flindersia maculosa*, which is well represented in Mr. J. H. Maiden's *Forest Flora*. The shape of the valves, and their outer surface is the same and the seeds show the tendency to extension into a short wing, top and bottom, as in *F. maculosa*. In the Baron's remarks on *Rhytidotheca Lynchii* he pointed out the affinities to *Flindersia* but stated that the fruit valves of *Flindersia* were echinulate and so differed from *R. Lynchii*, but that is not the case with *F. maculosa*, the fruit valves of which are not echinulate but only a little roughened. Baron von Mueller appears to have first placed *Flindersia maculosa* under a separate genus *Strzeleckia*. In his *Census of Australian Plants*, 1889, *F. maculosa* is called *F. Strzeleckiana*.

Specimens Nos. 330 and 341 seem to me to correspond with Baron von Mueller's *Phymatocaryon Mackayi*, figured in Plate II. of his work. The structure of the fruits and the marked murication of their surface indicates that what we have left was originally covered by a succulent pericarp. The surface of the valves of these fruits resembles in a remarkable manner that of the fruits of *Elaeocarpus*, for example, *E. grandis*, *E. obovalis* and *E. holopetalus* and several other species of the same genus in the Indo-Australian Region. The character is the same in all these. The number of the valves in the fruits of existing species varies from three to five, with the exception of the tiny fruits of *E. cyaneus*, which appear to be indehiscent.

In the accompanying plate the fruit valves under discussion are illustrated in Figs. 13, 14, 15 and 16.

Specimen No. 339 appears to be portion of a valve of a fruit like a large *Rhytidotheca* which I have named *R. major*. In Plate 69 it is shown under Fig. 12.

Note.—A revision of the whole series of fossil fruits from Haddon and other places is much to be desired. Since 1874, when Baron F. von Mueller published the First Decade of his *Fossil Fruits*, much information has been obtained as to the existing Flora of the East Coast

of Australia, and many flowers and fruits then unknown have been discovered and described. If this revision were undertaken I am sure that the late Baron, were he alive, would support the step; it is quite possible that the palaeontologist dealing with them, might be disposed to carry a few of the existing genera, such as *Owenia*, *Flindersia*, *Elaeocarpus* and others back into the nomenclature of the fossil fruits, just as there never has been any hesitation about the use of modern names for leaves such as *Cinnamomum*, *Quercus*, *Fagus*, &c. If these latter can be made use of for plants of Miocene and early Tertiary origin, it should not be a very rash step to use modern names for fossils from the Pliocene and Pleistocene deposits.

Plate 69.

Fig. 1.—*Penteune Clarkei*, F. v. M., No. 324. Side view of fruit.
Fig. 2.—*Penteune Clarkei*, F. v. M., No. 324. Back view of valve.
Fig 3.—*Penteune Clarkei*, F. v. M., No. 324. Inside view of valve.
Fig. 4.—*Phymatocaryon bivalve*, F. v. M., Nos. 328 and 340. View of interior.
Fig. 5.—*Phymatocaryon bivalve*, F. v. M., Nos. 328 and 340. View of fruit on edge.
Fig. 6.—*Phymatocaryon bivalve*. F. v. M., Nos. 328 and 340. Back view.
Fig. 7.—*Pleioclinis Shepherdi*. F. v. M., No. 321. Side view of fruit.
Fig. 8.—*Pleioclinis Shepherdi*, F. v. M., No. 332. Back view of valve.
Figs. 9, 10.—*Rhytidotheca Lynchii*, F. v. M., No. 329. Two views of same fruit.
Fig. 11.—*Concotheca turgida*, F. v. M., No. 327. Fruit from above.
Fig 12. *Rhytidotheca major*, *H. D.*, No. 339. Broken portion of valve.
Figs. 13-16.—*Phymatocaryon Mackayi*, F. v. M., Nos. 330 and 341. Valves of fruits.
Figs. 17-21.—*Concotheca turgida*, F. v. M., No. 338. Views of similar fruits.

[21.5.23.]

FOSSIL LEAVES FROM THE OPEN CUT, STATE BROWN COAL MINE, MORWELL.

By H. Deane, M.A., M. Inst. C.E., F.L.S., &c.

The Morwell "Brown Coal" Beds contain leaf remains in patches only, the greater body of the coal being destitute of them. The leaves found resemble in shape and venation those of some existing species of *Banksia*, *Dryandra*, *Lomatia*, *Ginkgo*, *Dammara*, *Phyllocladus*, *Tristania*, *Cinnamomum*, &c., the *Banksia* like forms being so far most abundant. There are other leaves, but they are too much broken up or the margins are too imperfect to permit of their relationships being determined with certainty.

Before dealing with the fossils in detail, I should like to make a few remarks on the existing flora, especially with regard to the general *Banksia* and *Dryandra*, for although there can be little doubt that some of the fossil forms belong to this tribe of the *Proteaceae*, there are certain characteristics developed which are worth calling attention to.

Representatives of the genus *Banksia* are found growing in all the States of Australia, but the most remarkable forms and the greatest variety are endemic to Western Australia. The species now living in Western Australia extend in no case to the more eastern States, nor are those of the eastern States found growing in Western Australia.

The living species of the genus *Dryandra* are exclusively Western Australian. This fact is all the more noticeable as some of the fossil leaves from Morwell, as well as certain fossil forms from New South Wales described by Ettingshausen in his "Contribution to the Tertiary Flora of Australia," have the curious pinnate or pinnatifid character which well-known *Dryandra* leaves possess, and the New South Wales examples referred to have been described and named by the above-mentioned authority as belonging to that genus. It is to be borne in mind that all living species of *Dryandra* do not possess the character mentioned. Some have entire or prickly-toothed leaves.

The species of *Banksia* now living in the eastern States may be said roughly to belong to one group. The leaves are in general outline linear, sometimes very narrow linear, obovate or spatulate, very often tapered at the base, but not towards the apex. They are sometimes entire as often occurs in *B. marginata* and nearly always in *B. integrifolia*, or they are strongly serrate, or toothed, or prickly. In the case of *B. integrifolia*, the prickly leaves are those growing near the ground. This peculiarity, which exists also in other botanical groups, looks like a provision to protect them against the browsing of animals. When the leaves are toothed or prickly, the sinuses between the teeth are as a rule concave throughout. The same plants, however, living in tropical regions have a tendency for the leaf margin just below the tooth to become straight or even convex. This is particularly noticeable in *B. integrifolia*. The lateral veins of most species are close and parallel to one another often running out from the midrib at an angle approaching a right angle (see *B. serrata* and *B. aemula*). The marginal teeth or spines are the terminals of lateral veins.

The Western Australian leaf forms of *Banksia* show greater variety. Some are like the eastern forms described above, but a large number are of a curious pinnate type like a magnified *Dryandra* leaf, with the pinnae roughly triangular in shape, the base being attached to the midrib and the apex running to a sharp point directed outwards. The most remarkable example of this structure is *B. grandis*, which has triangular pinnae $1\frac{1}{2}$ inches by $1\frac{1}{4}$ inches and leaves often more than a foot in length. There is also a plain pinnatifid type exemplified in *B. prostrata* and *B. repens* where the leaves resemble in shape fronds of *Polypodium* or *Lomaria*, and are over a foot in length. The pinnae are sometimes again divided so that the leaf becomes bipinnatifid.

I append diagrams representing types of *Banksia* leaves alluded to. The names and numbers given are those of the "Flora Australiensis" for convenience of reference. I have added some existing *Dryandra* leaves for comparison

By the help of these diagrams it will be seen that the so-called *Dryandra* form of leaf, as usually understood, is not peculiar to that genus, but occurs also in many species of *Banksia*. It may be that the fossil leaves with this character should be placed under *Banksia* and not under *Dryandra* at all. The fossils include leaves only, and no flowers nor fruits; it is therefore impossible at present to determine the question. Following Professor Ettingshausen's lead, however, I have called the serrated leaves *Banksia*, and those possessing more or less triangular pinnae *Dryandra*.

In Ettingshausen's *Contributions to the Tertiary Flora of Australia*, which was translated from the original work in German, and published among the *Memoirs of the Geological Survey of New South Wales*, the author describes a number of species of *Banksia*, also a leaf which he calls *Dryandroides Johnstoni*, and two species of *Dryandra*. It is not quite clear why he has created the genus *Dryandroides*; it was not necessary. It will be seen that the older forms of the two genera *Banksia* and *Dryandra* differ from the modern forms inasmuch as the lobes or teeth where they occur are more rounded on the outside and more directed forwards than is the case with the living species, the tendency in living forms being to stand straight out or even to be turned backwards. The same tendencies are seen in the Morwell leaves Moreover, although in the living species of *Banksia* the leaves tend to be obovate or spatulate and thus not tapered towards the apex, it will be noticed that some of Ettingshausen's species show a tendency to be tapered towards the apex, and in that Morwell species which I have named *B. fastigata*, the tapering towards the apex is very marked.

I think it may be inferred that the general temperature of the southern part of Australia when the brown coal of Morwell was deposited was higher than it is at the present day, that warmth and moisture abounded, and that hot dry winds did not occur, or at least were a rarity.

Description of Specimens.

Plate 61, figs. 1, 4; pl. 62, figs. 6, (?), 7; pl. 63, fig. 13.

Banksia fastigata, sp. nov. Leaves rather long and tapering both at base and apex. The name is given as descriptive of this character. Width, about $\frac{3}{8}$ inch, regularly toothed, the lobes turned towards the apex, sinuses often one-third of the distance from midrib to tip of tooth, lateral veins curved, one terminating at each tooth, and one at each sinus.

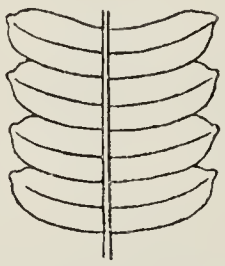


Fig. 140. Dentation and veining of B. *fastigata*; about double size.

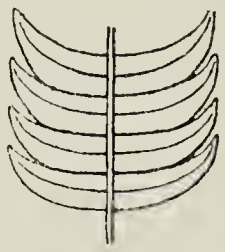


Fig. 141. Dentation and veining of B. *adunca*; about double size.

Plate 62, fig. 10; pl. 64, fig. 18.

Banksia adunca, sp. nov. Marginal teeth very regularly placed, curved strongly towards the apex of the leaf, more pointed and with

deeper sinuses than *B. fastigata.* The leaves resemble in some respect those of the existing *B. collina,* but the teeth are fuller, more curved and less like prickles. There is one lateral vein terminating at each tooth and one at each sinus.

Plate 62, fig. 9.

Dryandra urniformis, sp. nov. As only a fragment is preserved with four lobes, it is impossible at present and till more material is obtainable to determine the general shape of the leaf whether linear, obovate or tapered towards the apex. The lobes of the leaf are shaped in outline somewhat like a half urn; they are 7/16ths inch long, the width being about two-thirds.

Plate 62, fig. 8.

Lomatia praelongifolia, Ett. This seems to correspond with Ettingshausen's *Lomatia praelongifolia* described in his work above mentioned.

Plate 61, fig. 5; pl. 63, figs. 12, 15.

Dammara intermedia Ett. The fossils are in my opinion those of *Dammara,* and may be included under Ettingshausen's species described in the work above mentioned.

Plate 64. fig. 17.

Phyllocladus Morwellensis, sp. nov. The figure shows the apical portion of a twig of *Phyllocladus.* It has the characteristics of that genus, but it differs from the fossil plant from Vegetable Creek, N.S.W., described in Ettingshausen's *Tertiary Flora of Australia.* The figure, which is double size, clearly shows the shape and venation of the portion, and no further description is required. So far the fossil is peculiar to the locality, and I have named it *P. Morwellensis.*

Plate 63, fig. 11.

Ginkgo sp. The fragment depicted is undoubtedly portion of a *Ginkgo* leaf, but the outline and other characters are not sufficient to determine whether it belongs to an already described species or not. I have provisionally named it *G. Morwellensis.*

Plate 63, fig. 14; pl. 64, figs. 21, 22.

Cinnamomum praevirens n.sp. The figures represent a type of leaf of interesting character, but rather difficult to diagnose on account of the obscurity and incompleteness of the details. After careful examination and comparison with leaves of living species I have made out sufficient particulars to enable me to determine the true affinities of the fossil leaves.

Figs. 14 and 21 show the shape of the leaf which is lanceolate acuminate. The texture is evidently firm, almost leathery, so much so that some portions of the leaf in Fig. 21, in which the finer nervation is preserved, are almost *Eucalyptus*-like in character. The margin of the leaf is entire and the irregularities here and there noticeable are evidently due to abrasion or fracture. The lateral veins are rather distant from one another; they start from the midrib at an angle of about 60°, but they curve round and seem each to anastomose with that immediately above. Between these principal lateral veins and starting

more or less at right angles to the midrib is a series of subsidiary short veins rather close together. Some of these appear to turn downwards and to connect with the principal lateral vein next below.

A similiar general scheme of venation is visible in several botanical groups, but taking the firmness of the leaf substance, the position and curvature of the lateral veins and the character and arrangement of the subsidiary veins mentioned, into consideration, the most remarkable resemblance among living plants is found in the leaves of *Cinnamomum virens* and *C. Oliveri*. The firmness of the fossil leaves and their shape is quite *Cinnamomum*-like. The lateral veins are particularly like those of the leaves of *C. virens*, which have also strongly developed subsidiary veins starting out of the midrib at right angles, although not so closely arranged as in the fossil. The subsidiary veins in the fossil resemble those of the leaves of *C. Oliveri* very closely indeed. It will thus be seen that the fossil leaves resemble in a very remarkable degree the leaves of the two living species of *Cinnamomum* mentioned, and this justifies me in the conclusion as to their affinity. In order to mark these important conclusions I have decided to name the fossil leaves *C. praevirens*.

As it might be thought misleading by many who have not had full opportunities of observing the variations of leaf type in a genus, and it might be concluded that a mistake has been made in including these leaves under *Cinnamomum* seeing that their venation departs so largely from the ordinarily recognised *Cinnamomum* type, it will not be out of place to make a few remarks on the subject.

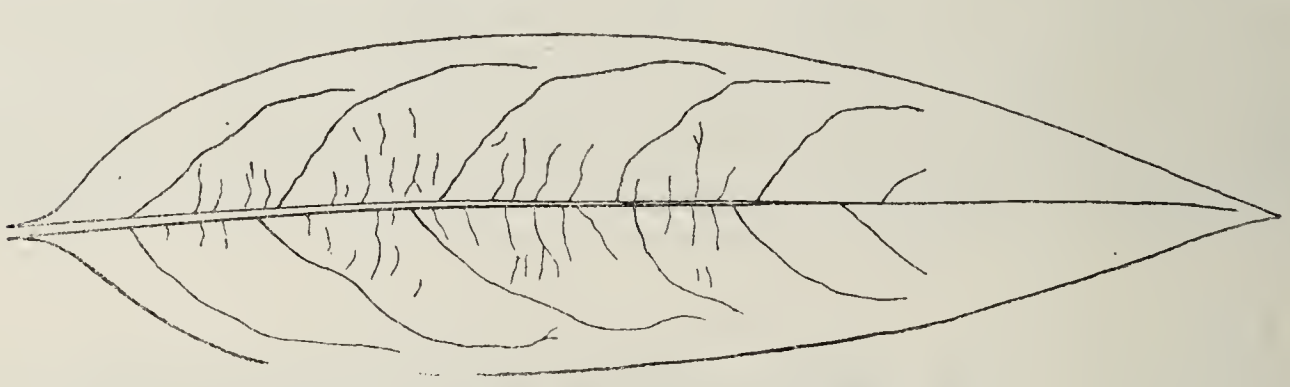


Fig. 142. *Cinnamomum virens* von Mueller sp.

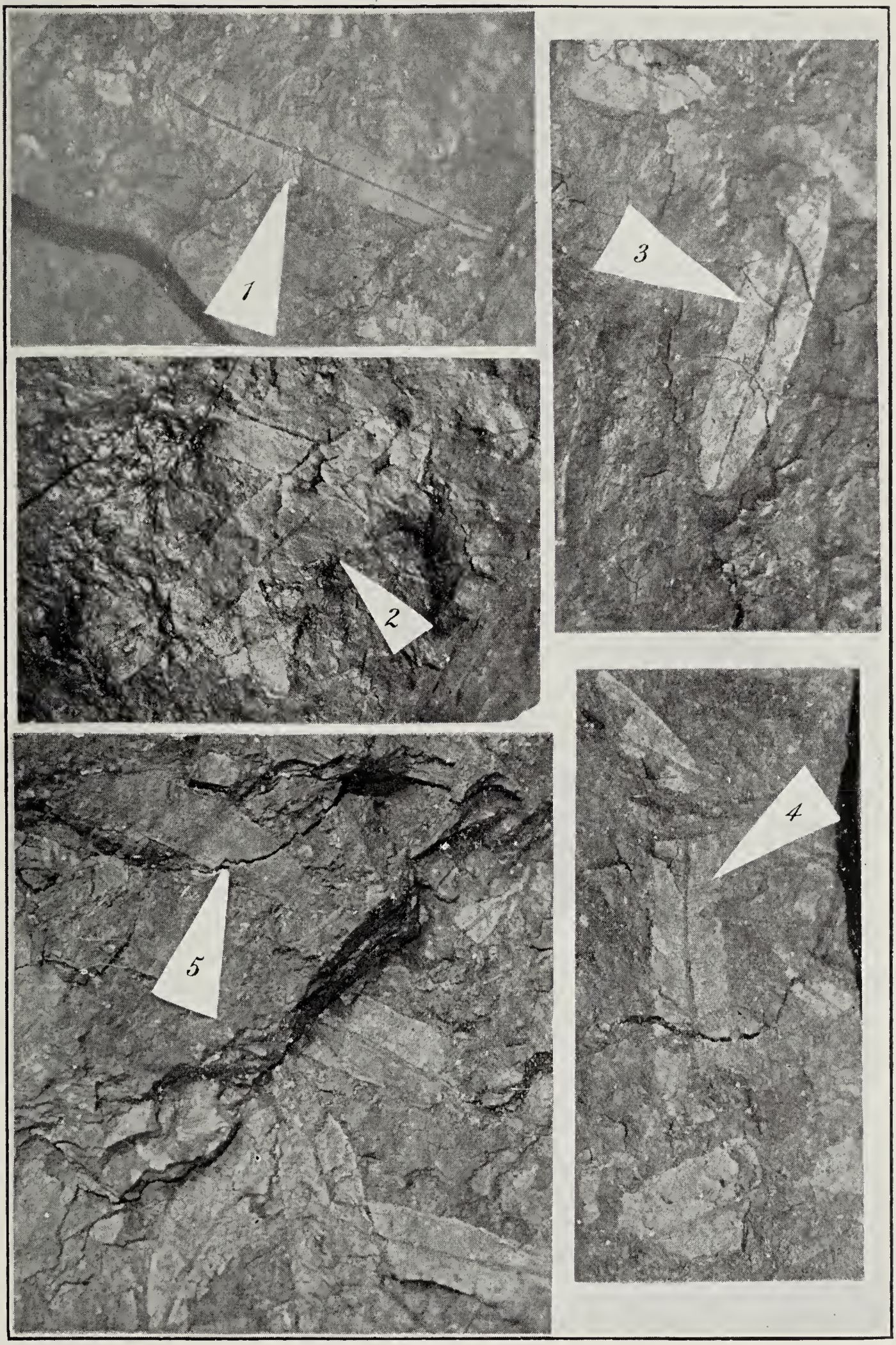
The leaves of the large majority of species of *Cinnamomum* are distinguished by having the lowest pair of lateral veins long and continued upwards enclosing as it were a very considerable portion of the whole surface of the leaf, and fossil leaves with this character of venation have been commonly referred to *Cinnamomum* because they possess this character and for no other reason. The leaves of the living species *C. virens and C. Oliveri* do not possess this character. On the other hand the possession of the long lower pair of lateral veins is not peculiar to the genus *Cinnamomum*. *Litsaea dealbata* exhibits these veins in a remarkable degree, and the genus *Cryptocarya* includes several species which have them also.

Plate 61, figs. 2, 3 ; pl. 64, fig. 19.

Tristania (?)—The shape of the leaves and their venation afford sufficient justification for placing them under *Tristania*.

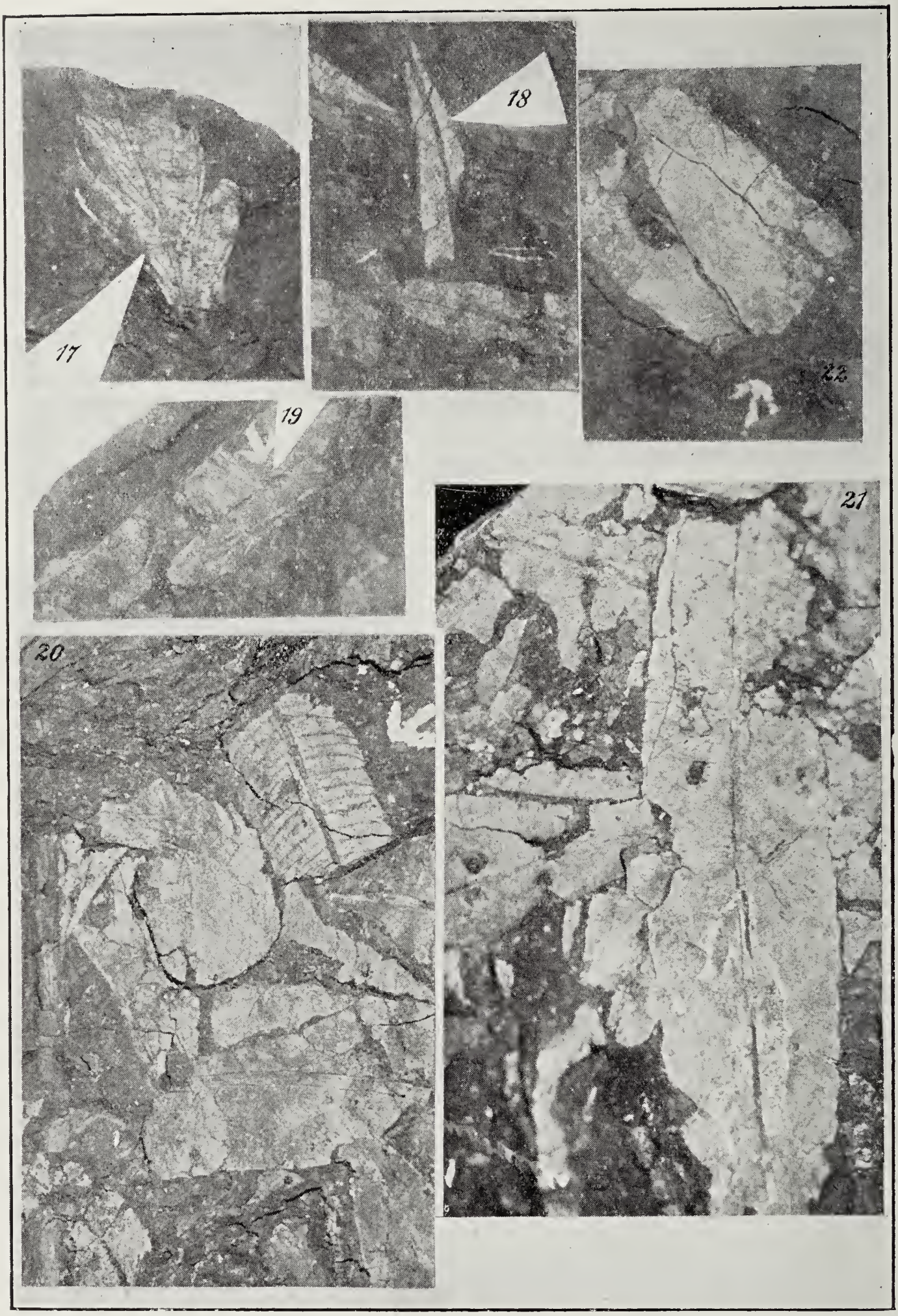
The type specimens are in the National Museum.

In conclusion, I wish to acknowledge the very kind assistance rendered to me by Mr. F. Chapman, A.L.S.



F.C., photo.

TERTIARY LEAVES, MORWELL.



F.C., photo.

TERTIARY LEAVES, MORWELL.

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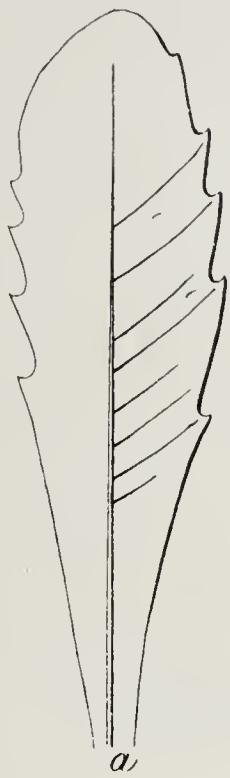
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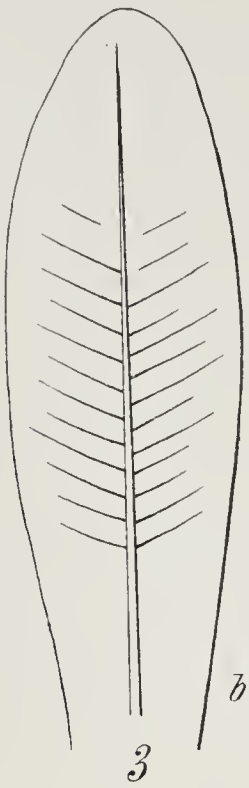
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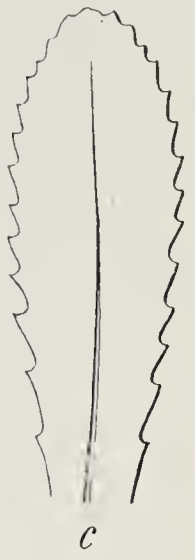
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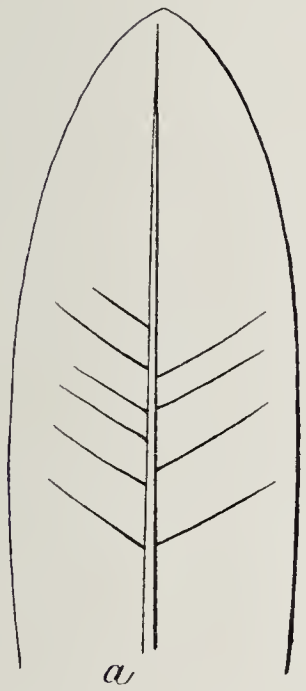
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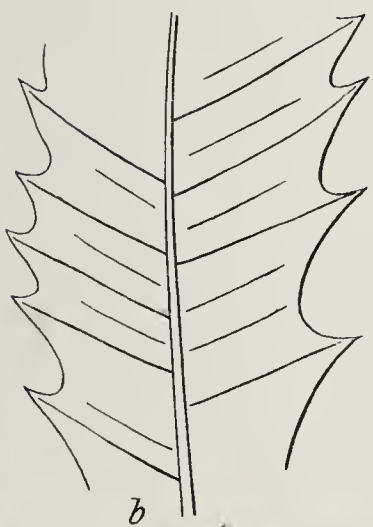
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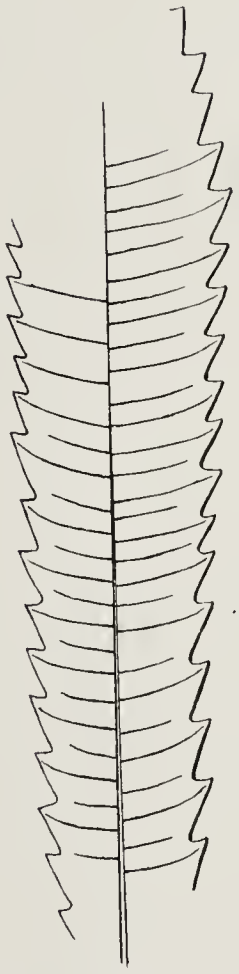
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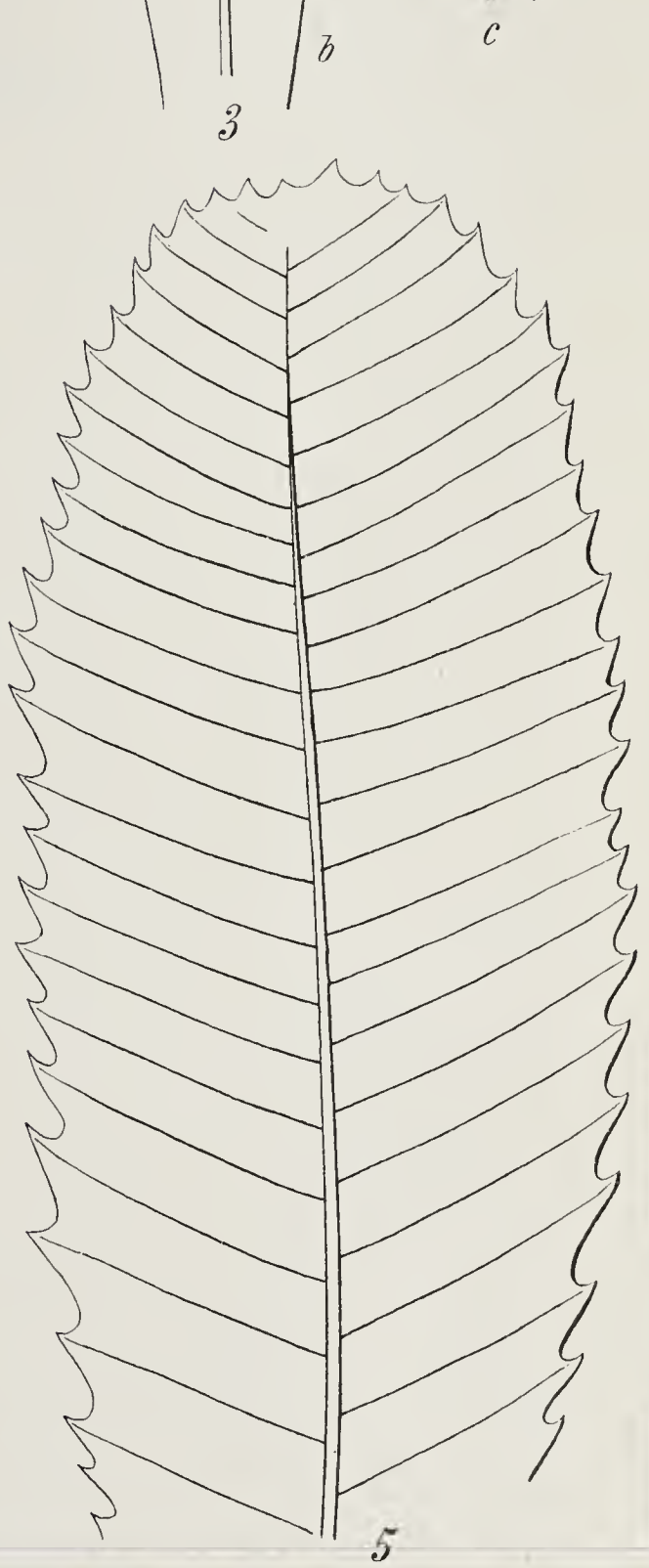
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Living Types of Banksia Leaves; Eastern Species.

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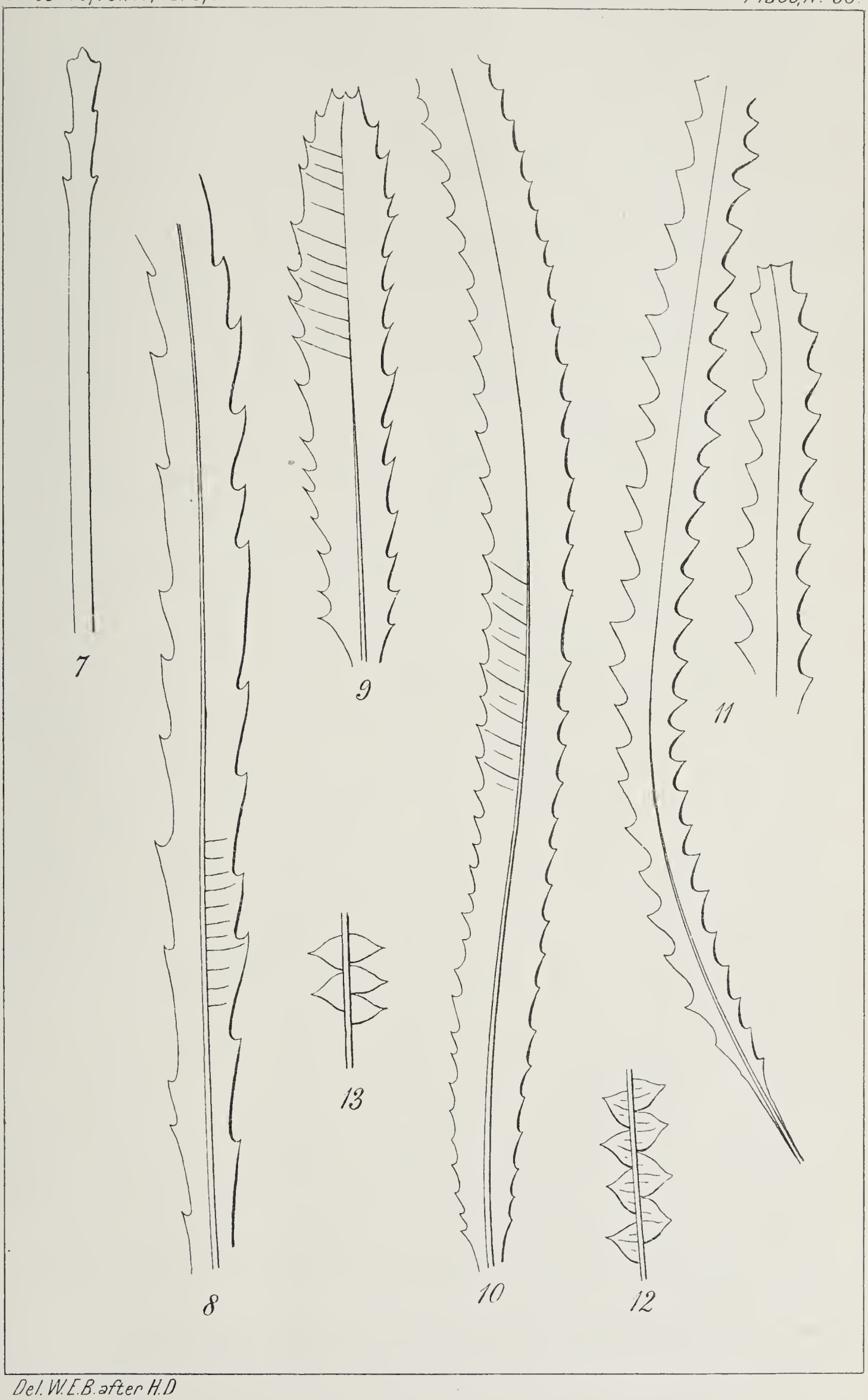

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Living Types of Banksia Leaves : Western Species.

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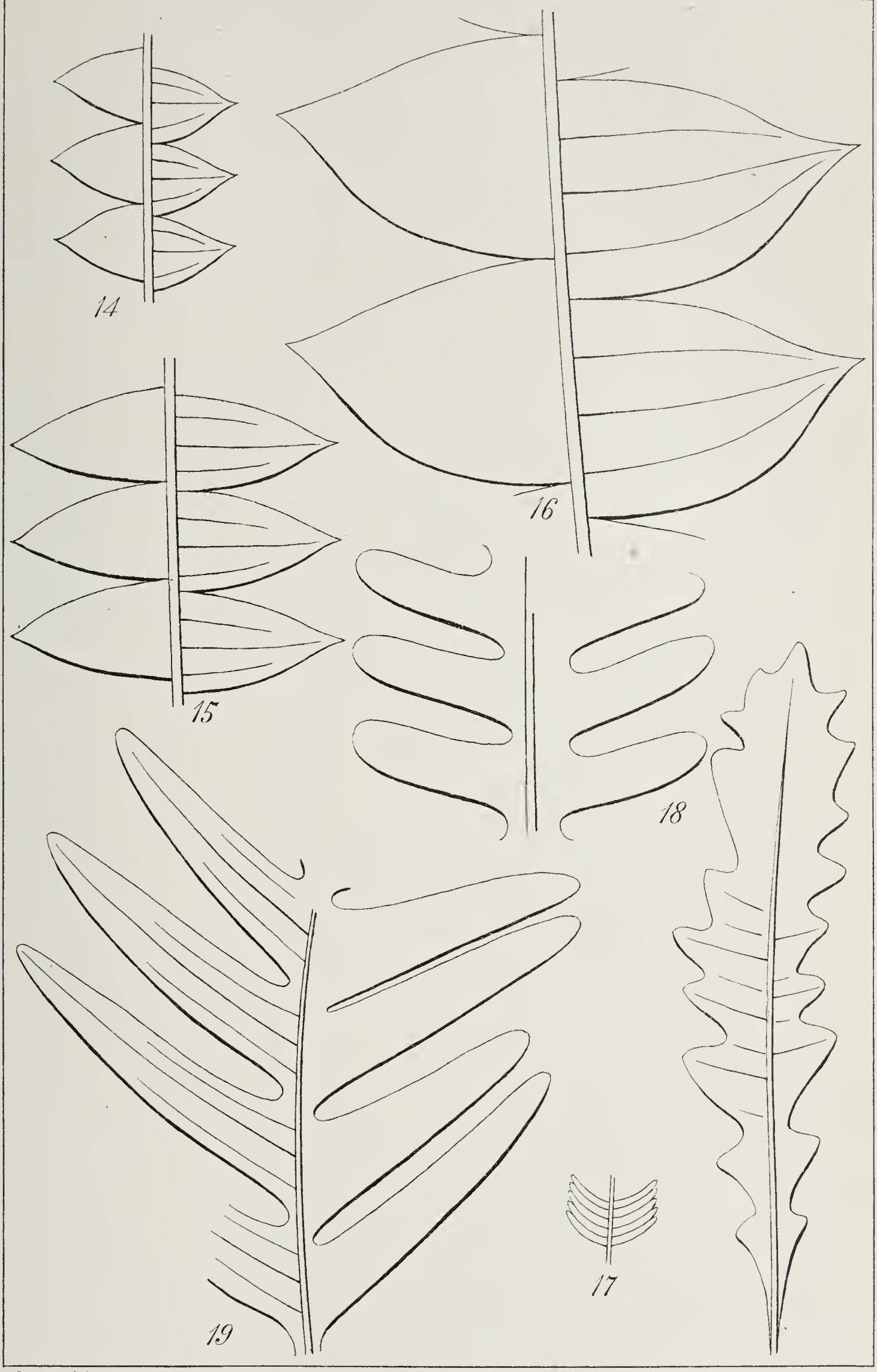

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Living Types of Banksia Leaves; Western Species.

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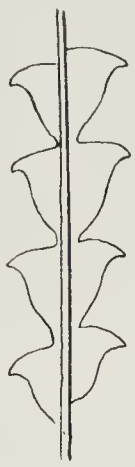

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Del. W.E.B. after H.D.

Living Types of Dryandra Leaves ; Western Species

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3. *Tristania* (?)
4. *Banksia fastigata*, sp. nov.
5. *Dammara intermedia*, Ett.

Plate 62.

Fig.

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7. ,, (?)
8. *Lomatia praelongifolia*, Ett.
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Plate 63.

Fig.

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15. *Dammara intermedia*, Ett. × 2
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Plate 64.

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20. Not determinable.
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22. ,,

Plate 65.

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Fig.

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Plate 66.

Examples of living types of *Banksia* leaves, Western species.

Fig.

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Plate 68.

Examples of living types of *Dryandra* leaves, Western species.

Fig.

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[8.3.23.]

THE LATE HENRY DEANE, M.A., M.INST.C.E., F.L.S.

By F. Chapman, A.L.S.

For his scientific researches in the realm of Australian palaeobotany, Mr. Deane will be long remembered. Coupled with his enthusiastic devotion to his science was a genial personality which endeared him to those who had the privilege to meet him, either at scientific gatherings or in friendly discussion.

Mr. Deane was born at Clapham, London, on 26th March, 1847, and although he had reached the ripe age of 77, the news of his decease came as a shock to his friends, who had hoped to see the results of many more years of study from his pen.

He took his degree of M.A. at the Queen's University, Galway, and also held the same degree from the Sydney University. His long career of work as an engineer included that on the Metropolitan and Metropolitan Districts railway, London; on the East Hungarian railways, Transylvania; and at the shipbuilding works of the Danube Steam Navigation Company, Althofen, Hungary. In 1879, having recovered his health after a breakdown, Mr. Deane came to Australia, and was appointed surveyor in the Railway Construction Branch of New South Wales. In 1890, after filling various responsible positions in that State as District Engineer and Inspecting Engineer, he was appointed Engineer-in-Chief. In 1894 he was commissioned to make a world trip to study the subject of light railways and tramways, and on his return the system of pioneer lines was started, as also, in conjunction with Mr. Elwell, the inauguration of the Sydney electric tramway system. He made another trip to America, England, and Europe in 1904 to report on matters useful to the New South Wales railways, and finally he retired from the State Government appointment in 1906. Mr. Deane was soon after commissioned by the Commonwealth Oil Corporation to build and work a railway to their mines in the Wolgan Valley. Running through steep and rugged country, this line involved grades and curves sharper and steeper than any hitherto worked in Australia. Mr. Deane was also engineer-in-chief to the Commonwealth railways from 1912-14.

He was elected associate member of the Institute of Civil Engineers in 1874, and a full member in 1886. Twice president of the Royal Society of New South Wales, and for two years president of the Linnean Society of that State, his scientific attainments as an engineer and botanist were well recognized, and one of his addresses dealt with forestry.

It is in regard, however, to Mr. Deane's palaeobotanical work that his name is so well known to geologists. No one of his time, it is safe to say, was so well equipped for the work on tertiary fossil botany, which he had first undertaken many years ago, for he had made a special study of the leaf-form and venation of all the components of our living Australian flora.

Amongst Mr. Deane's valuable researches may be numbered the two papers published by the Linnean Society of New South Wales in 1900 and 1901, which critically investigated von Ettingshausen's conclusions regarding the existence of European types of Australian fossil floras.

Of the more important of Mr. Deane's work descriptive of Victorian tertiary floras may be mentioned "Notes on the Fossil Flora of Pitfield and Mornington" and "Further Notes on the Cainozoic Flora of Sentinel Rock, Otway Coast"; whilst two interesting and extremely valuable papers—"On the Leaves of Morwell Brown Coal" and on "Fossil Fruits from the Deep Leads of Foster," are now published posthumously, in these records. At the time of his death, Mr. Deane was engaged on a valuable line of research in regard to the correlation of the fruits of the deep leads with those of living plants; and his conclusions, which I learned from frequent conversations with him, went much farther than those of Baron von Mueller, who first described them.

From one who numbered among his earlier personal friends such men as Alfred Russel Wallace and Dr. Wools, much helpful information would often be obtained, and the writer, like many others, found him always ready to discuss subjects of current palaeobotanical interest.

Selected List of Papers, chiefly Palaeobotanical, by Henry Deane, M.A., F.L.S.

1897.—"President's Address." Proc. Linn. Soc. N. S. Wales (1896), 31st Mar., 1897, pt. 4, pp. 821-859.

1900.—"Observations on the Tertiary Flora of Australia, with especial reference to Ettinghausen's Theory of the Tertiary Cosmopolitan Flora." Proc. Linn. Soc. N. S. Wales, 1900, pt. 3, 25th July (issued 22nd Novr., 1900), pp. 463-475.

1901.—"Observations on the Tertiary Flora of Australia, with especial reference to Ettinghausen's Theory of the Tertiary Cosmopolitan Flora. Pt. II., on the Venation of Leaves and its Value in the Determination of Botanical Affinities." Proc. Linn. Soc. N. S. Wales (1900), pt. 4, 26th Sept. (issued 20th May, 1901), pp. 581-590, pls. XXXV.-XXXVIII. and XXXVIII. *bis*). [An important and suggestive paper.]

1902.—"Notes on Fossil Leaves from the Tertiary Deposits of Wingella and Bungonia." Rec. Geol. Surv. N. S. Wales, vol. VII., pt. 2, pp. 59-65, pls. XV.-XVII.

1902—"Preliminary Report on the Fossil Flora of Pitfield, Mornington, Sentinel Rock (Otway Coast), Berwick and Wonwron." Rec. Geol. Surv. Vict., vol. I., pt. 2, pp. 13, 14.

1902.—"Notes on the Fossil Flora of Pitfield and Mornington." Rec. Geol. Surv. Vict., vol. I., pt. 2, pp. 15-20, pls. I. and II.

1902.—"Notes on the Fossil Flora of Berwick." *Ibid.*, pp. 21-32, pls. III.-VII.

1903.—"Description of Two New Plants from the Tertiary of New South Wales (*Pteris abbreviata* and *Grevillea darlingoides*)." Rec. Geol. Surv. N. S. Wales, vol. VII., pt. 3, pp. 231, 232, pls. XLV., XLVI.

1904—"Further Notes on the Cainozoic Flora of Sentinel Rock, Otway Coast." Rec. Geol. Surv. Vict., vol. I., pt. 3, pp. 212-216, pl. XX.

1907.—"Notes on Specimens of Fossil Leaves from the Warrumbungle Mountains." Rec. Geol. Surv. N. S. Wales, vol. VIII., pt. 3, pp. 189-191, pls. XXXIV.-XXXVI.

1924.—"Fossil Leaves from the Open Cut, State Brown Coal Mine, Morwell." Rec. Geol. Surv. Vict., vol. IV., pt. 4, pp. 492-498, pls. XII.-XIX.

1924.—"Tertiary Fossil Fruits from the Deep Lead, Foster, South Gippsland." Rec. Geol. Surv. Vict., vol. IV., pt. 4, pp. 489-492, pl XX

ON THE SILURIAN AND DEVONIAN FLORAS, AND THE IMPORTANCE OF THEIR DISCOVERY IN VICTORIA.

By Adele V. Vincent, B.Sc.

As early as 1842 we find recorded by Vanuxem[1] plant remains of what are now included in the Psilophyton group (see *postea*). This we might regard as the beginnings of records of a Devonian flora. Shortly afterwards Logan discovered a Devonian series in Pennsylvania and Gaspé (Canada). Deposits were found in sandstones and shales of various colours, and with some conglomerates and thin-bedded coarse limestone. He pointed to the presence of aerial branches with characteristic dichotomous branching, a smooth surface, no scars, and interrupted ridges, spirally arranged. Hugh Miller, working in the Old Red Sandstone, found many stem impressions which he merely termed "fucoids," missing the significance of the dichotomy. Some years later, in 1847, Göppert described in his reports some impressions from the transitional rocks. These were not figured until 1852, under the species *Haliserites Dechenianus*[2]. They showed a marked similarity to impressions which were at the time attracting Dawson's attention in America.

To Dawson can be attributed much of the credit of pioneering work on Devonian floras. At this particular period he was engaged on a study of *Psilophyton robustius*[3]. The commonest of *Psilophyton* species worked out by Dawson was *P. princeps*. This genus apparently extended right through all the Denovian strata of North America. In Gaspé it was present in the sandstone about 2 feet deep, in all states of preservation, and with most of the stems flattened. All the beds appear to have been crowded with the rhizomes of these terrestrial plants. These were found in situ, lying in a manner which showed that they crept along in immense numbers, over flats of sandy clay. From these arose aerial stems, branching dichotomously and covered with interrupted ridges; the

(1) Nat. Hist. New York, Geol. pt. III. p. 161. 1842.
(2) Quart. Journ. Geol. Soc. Lond. 1859, vol. XV.
(3) Foss. Flora d. Uebergangs. p. 88. 1852.

leaves were undeveloped, and the fructification borne terminally on some of the erect shoots. The general internal structure seems decidedly simple. A vascular cylinder was present, formed of elongated woody cells, which surrounded vessels probably of a tracheidal nature, with scalariform thickenings, and, therefore, shows relations to present-day fern life. The sporangia were borne on slender curved branches, either terminally or laterally.

Turning now to the specialized classification of the *Psilophyton* group, we find four main species described by Dawson. In addition to *P. robustius* and *P. princeps* mentioned above, *P. elegans* and *P. glabrum* have been described as occurring in the Old Red Sandstone of Scotland. *P. princeps* is by far the most common, and includes a variety, *ornatum*. This is dichotomously branched, with aerial shoots covered with emergences and spines and growing vertically from subterranean shoots. Sporangia are detected, having multi-layered walls. *P. elegans* is described as "slender stems borne in tufts from their rhizomes, bifurcating and curved at their summit. The stems are macroscopically smooth, with very delicate wrinkles." *P. grabrum* has been recorded from New Brunswick; the stems were also smooth and somewhat flattened.

Devonian beds have been found in all parts of the globe, and the distribution of the *Psilophyton* group seems to be unrestricted to any particular country.

The occurrence of this group is recorded in—

Scotland (Lower and Middle Old Red Sandstone);
Belgium (Lower Devonian);
Germany (Upper Devonian);
Norway (Lower Devonian);
United States of America (Lower, Middle, and Upper Devonian);
Canada—Gaspé (in all three stages);
Australia (Upper Silurian and Lower Devonian).

This list is by no means complete, but it will suffice to show the world-wide distribution of the group. In America a classification table shows--

Lower Devonian—*P. princeps* in Gaspé, Canada.
Middle Devonian—*P. princeps* in Gaspé and New York.
Upper Devonian—*P. princeps* in Gaspé, New York, and Maine.
P. elegans in New Brunswick.
P. glabrum in New Brunswick.

The most recent work on the *Psilophyton* group has been carried out by Halle[4] and Kidston and Lang[5], both working independently. Halle studied Lower Devonian specimens from Norway. He was anxious to clear away the ambiguity which clung to the term *Psilophyton* and the varied species grouped under this name by Dawson. He therefore collected all those possessing non-spinous fruiting stems under the name *Dawsonites,* leaving *Psilophyton* to include those stems covered with spines. As Newell Arber points out, such a separation seems scarcely justified on the basis of external appendages. These, in the process of preservation, might be easily destroyed, and it is extremely difficult to state if these were really originally present or not.

(4) Kungl. Svenska Vetenskaps. Akad. Handl., vol. LVII. No. 1. 1916.
(5) Trans. Roy. Soc. Edin., vol. LI., pt. 3. 9117.

The most important work in this connexion is that of Kidston and Lang. They concentrated on Scottish specimens from the Old Red Sandstone beds, and their descriptions have recently been published[6]. A complete study of the specimens has been possible, as the stems are found *in situ,* in beds of silicified peat, and the plants have been found to agree in every essential with those collected by Dawson as species of *Psilophyton.* Their habitat is similar, the flora being described as found in peaty soil, practically composed of the decaying remains of the same species; this agrees with the terrestrial habit of *Psilophyton.* Kidston and Lang have been able to present a complete account of the external characteristics of the group, together with a clear description of the internal structure of the plants at their disposal. The first species they worked upon they called *Rhynia.* This was found as an interwoven mass of rhizomes loosely occurring in the amorphous peaty matrix, crowded and compressed in the lower part. The aerial stems can be exposed by fracturing the chert. The general characters of the group are stated as "Plant, gregarious and leafless, consisting of subterraneous rhizomes attached by microscopic rhizoids. Erect, dichotomously branched cylindrical aerial stems, with stomata present. The stele consists of a zone of phloem surrounding a strand of tracheids; sporangia are cylindrical, without columella, and terminal on aerial stems. Spores homosporous, with cuticularized walls; spores developed in tetrads."

A feature which seems apparently absent is the spinous processes of *P. princeps.* But these are actually represented by analogous structures in the form of lateral bulges or protuberances. These are very similar when magnified. They have been shown to be localized divisions of the epidermis and of the layers immediately below in the vicinity of the stoma.

These authors have described two species of *Rhynia, R. Gwynne-Vaughani* and *R. major.* These are similar, differing only in size and in the fact that in *R. major* there are no lateral projections nor adventitious branches corresponding, in place of origin, to them. This brings to mind the fact that spines are absent from such species as *P. glabrum.*

A second plant worked out by Kidston and Lang is *Hornea Lignieri.* This, like *Rhynia,* is leafless, and the two agree in general structure. In the sporangia of *Hornea,* however, there is a columella surrounded by a dome-shaped spore sac. The significance attaching to the discovery of this feature will be dealt with later. *Rhynia* and *Hornea* have thrown much light on the development of Pteridophyta, as they are the most ancient plants of which the entire structure is known, and represent the simplest types of fern life. In their relation to modern species they seem nearest to *Psilotum* and *Phylloglossum.* The stems of *Hornea* arise from a tuberous parenchymatous structure, which closely resembles the protocorm of *Phylloglossum.*

Rhynia and *Hornea,* as previously stated, are leafless forms, and the extreme simplicity in the structure of the sporophyte helps us to bridge the wide gap which separates the sporophyte of the Bryophytes and Pteridophytes. In the latter the sporophyte has not only gained its independence, but has reached a stage of marked complexity; whereas the gametophyte has become more or less insignificant. *Rhynia* and

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(6) Trans. Roy. Soc. Edin., vols. LI., LII., LIII.

Hornea both show algal characteristics in the absence of roots and the development of their reproductive organs, which arise by the transformation of the extremity of a branch, as in *Vaucheria*.

It is easy to see that *Psilophyton* and *Rhynia* are closely related. The plants both consist of aerial stems arising from underground rhizomes, and also show a marked absence of leaves. Although roots of *Rhynia* have not yet been discovered, there is no evidence to prove that these may not be found in the future.

Schenck has pointed out a supposed similarity between the sporangia and those of some algal types. In both cases the sporangium is a specified region of the plant body enclosing a large number of tetrasporangia, which by division give rise to spores. This he considers is found in such algae as produce stichidia such as *Plocamium*. But in spite of this we must remember that the algal plant represents the gametophyte, whereas that of the ferns is the sporophyte generation.

Before leaving the Psilophyton group, which represents the majority of the early Devonian flora, there is yet another collection of plants to be dealt with. These display a marked lycopodiaceous external appearance. *Thursophyton* was described by Nathorst in 1915. Its aerial stems are dichotomously branched, but densely covered with small scale-like emergences which suggest a Lycopod. For this reason it was first referred to *Lycopodites,* a Carboniferous genus, from which, however, it fundamentally differs. Although it cannot be definitely proved, it is probable that these scales may actually represent the beginings of leaf structures, though these show no vascular structure. Another plant, *Ptilophyton,* is also similar in structure. Carruthers[7] has described a plant with dichotomously-branched axis, covered with small lanceolate scales. This he calls *Psilophyton Dechenianus,* but its real position is with *Ptilophyton*. The axis is short and profusely branched, the branches being closely covered with tiny scale-like structures. In addition, there are other species described by Nathorst (1915), and Potonié and Bernard (1904), as occurring in Norwegian and Bohemian Devonian beds.

Rhynia and *Hornea* do not, however, represent the simplest examples of Devonian flora, though they are the most primitive of Pteridophytes. There is, in addition, a collection of plants which are of a thallophytic nature. Don and Hickling in recent years[8] redescribed an algal form, *Parka* (of Fleming, 1831), which clearly represents some low Thallophyte, and is akin to recent forms such as *Lithophyllum*. The importance of its discovery is dealt with by Newell Arber. A form which comes nearest to *Psilophyton* in external appearance is *Hostimella,* described by Potonié and Bernard in 1904. This shows repeatedly bifurcate divisions. Perhaps the most interesting plant in this connexion is *Sporogonites*. Halle in 1916[9] described a plant structure from the Lower Devonian of Norway, showing a wall of several layers of cells, a thick sporogenous bract and a sterile central columella; spores tetrahedral and globular. The relation of this form to *Psilophyton* could not be proved until some well-petrified material could be obtained, and this did not seem to be forthcoming until the discovery of well-petrified specimens of *Hornea* cleared away the mystery. This showed

(7) Journ. of Botany, vol. II. N.S. 1873.
(8) Quart. Journ. Geol. Soc. Lond. vol. LXXI. 1917.
(9) Handl. k. Svenska Vetenskaps-Akad., vol. LVII., No. 1.

a bryophytic character in the presence of a columella which was surrounded by a dome-shaped spore sac. This fact enables *Sporogonites* to be placed with the other members of the Psilophyton flora.

This account briefly indicates the nature of Devonian Psilophyton flora found in various countries throughout the world. We will now consider the Devonian flora that has been discovered in Australia. As early as 1866 McCoy showed the existence of a Devonian series in Gippsland, and described a typical marine fauna of corals and fishes, which were comparable with European facies. Three distinct plants were described from the beds overlying this series, namely, in the Upper Devonian, from the Iguana Creek, Mitchell River, under the names of *Archaeopteris Howittii*, *Sphenopteris iguanensis* and *Cordaites australis*.

In 1897 W. S. Dun described some Devonian plant remains near the Genoa River, Co. Auckland, New South Wales[10]. These beds are typical of other Upper Devonian formations in Australia, and are composed mainly of conglomerates, sandstones, and shales. Like most of the fossils of this age, the specimens obtainable are most fragmentary in character. They consisted of Pteridophytes, and were far above Psilophyton in complexity. They showed deeply incised pinnules, some closely resembling *Pteridium aquilinum*, others being more akin to *Adiantum* in external appearance.

Most of the Victorian plant fossils found in the lowest part of the formation are represented by long, straight or slightly curved stems, showing a midrib. Well-preserved specimens have also sporangia-like bodies attached to the stems or branches, and also circinate terminations, as already described by F. Chapman[11]. A further research on these and similar specimens will be especially interesting from the fact that many fragmentary specimens of the Psilophyton flora, which promise better material on further research, are represented. Most of the material has been collected from around Walhalla and Wood's Point districts; the stratigraphical series there represented comprising various formations of the Palaeozoic.

The older rocks in association with the plant-bearing Siluro-Devonian beds are Upper Ordovician slates developed in the western area of the Jordan River Valley and in the Black River district. The Siluro-Devonian formations are here of the utmost importance. The Jordan River beds cover a great area of country, embracing part of the Jordan River, Goulburn River, Black River, and Wood's Point township. Towards the eastern side of the beds the rocks are highly cleaved, and, therefore, fatal for the preservation of the fossils, but more or less satisfactory specimens have been found, especially towards the western parts. Plants described by Chapman as *Haliserites* have been located at the Goulburn River and Wood's Point. Two specimens from this locality were sent to me, both supposed to belong to the Psilophyton group. One of these impressions shows dichotomy in the branching of the stem. This is one of the chief characteristics of *Psilophyton*. But it would be difficult to place this specimen in this genus. It is a smooth

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(10) On the Devonian Plant-bearing beds on the Genoa River, County of Auckland. Rec. Geol. Surv. N.S.Wales, vol. V., pt. 3., 1897. pp. 117-121, pls. X., XI.

(11) Newer Silurian Fossils of Eastern Victoria. Rec. Geol. Surv. Vict., vol. III., pt. 2, 1912. pp. 224-223. pls. XXXVII. and XXXVIII.

slender structure, and may quite well be referred to as *Hostimella.* This genus was described by Potonié and Bernard from the Middle Devonian beds in Bohemia as a slender, branched, bifurcating system without emergences. The other specimens from Woods' Point showed a stem-like structure with a decided central depression running lengthwise down the stem. There can also be seen what closely resembles a portion of a lycopodiaceous cone showing merely the central axis and sporophylls on sterile bracts, the ends of which are sharply turned upwards, and somewhat like *Lepidodendron* in appearance. If this deduction is correct, this formation should be high in the series.

The Walhalla beds cover a large tract of country, which extends from the Thomson River area eastwards through Walhalla. The base of the beds are formed of conglomerate, over which lies a heterogeneous mixture of sandstone, shelly sandstone, quartzose sandstone, grits, and other fragmentary beds, with occasional shales, slates, and variegated mudstones. All of these contain fossils, including specimens of *Haliserites,* which have been described from various parts around the Thomson River and Cooper's Creek, though the majority are too indistinct to determine. One specimen from the Thomson River showed a marked resemblance to *Arthrostigma* (No. 22058), a genus which has been described by Dawson. This showed a broad stem with sharp emergences on both sides. Others showed the stems covered with small spines arranged more or less spirally. The remainder were but faint stem-like impressions, occasionally showing dichotomous branching.

During the long period of research on Devonian floras, much light has been thrown on the origin of Pteridophyta, and also on the sporophyte generation in plant life. They suggest a source from which fern life has been evolved. Like ferns, they have underground rhizomes, from which aerial branches arise vertically. There is no definite root or leaf system, showing that as yet they have not become completely adapted to land conditions as present-day autophytic green plants. But they do in some cases show the appearance of stomata on the sporophyte, and the beginning of a vascular system, which, like ferns, is tracheidal in nature. They, too, show algal relations in their external appearance and in the development of the sporangia, which seem to arise by changes in the tips of certain branches. The sporangia of *Hornea* also help to form a link to the Bryophytes in the development of a columella, which, like that in a typical moss, is completely surrounded by a spore sac filled with cuticularized spores, developed in tetrads.

It is generally agreed that these Devonian plants which have been brought to light in Scotland, North America, Australia, and other parts of the world, do represent the ancestors of land life from which vascular Cryptogams and Phanerogams have arisen. Lignier has put forward the view that they have given rise to Filicinean plants on the one hand and Lycopods on the other. This conception was supported by the discovery of *Asteroxylon,* a form densely covered with small, scaly, lycopodiaceous leaves. The stele also shows relations to *Lycopodium* in the arrangement of the xylem and phloem. *Asteroxylon* then forms a link between the Psilophyton flora and Lycopods, whereas *Stauropteris* helps to link them with the Filices.

Although these fossil plants help to explain the transition from the gametophyte, a generation adapted to aquatic conditions, to the complete independence of the sporophyte, they do not in any way bridge the gap. What is needed is a plant intermediate between a Liverwort and *Rhynia* or *Hornea*. A Liverwort represents a gametophyte with the sporophyte, a simple spore capsule, parasitic on it. The Rhynia plant, however, is a simple independent sporophyte. Not until this intermediate form is found can the gap be completely filled between the Bryophytes and vascular Cryptogams, and the evolution of plant life more fully understood.

GRAPTOLITES FROM MT. EASTERN.

By R. A. Keble and Wm. J. Harris.

The following notes deal with a collection of graptolites made by the writers from Upper Ordovician beds outcropping on the spur trending north-west from Mt. Easton. The sketch plan indicates the approximate positions of the specimens. No trigonometrical station being

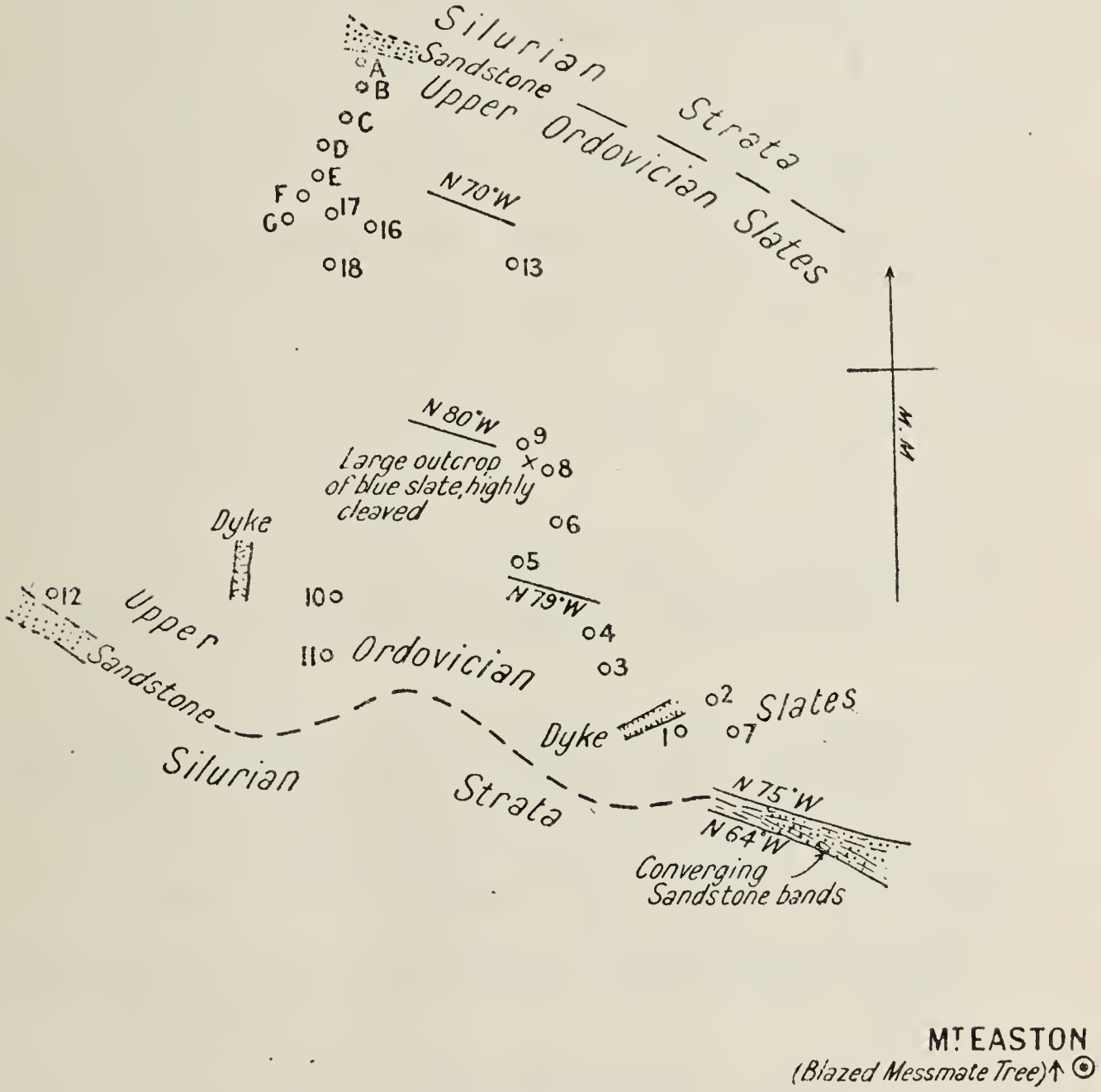

Fig. 143. Sketch Locality Plan, showing strike of the strata.

available within several miles, a large messmate tree on the highest point of Mt. Easton was used as a reference point. The tree is marked with a broad-arrow, and should easily be recognized growing between large sandstone boulders on the extreme summit of the mountain. The places where Mr. Baragwanath knapped the slates for graptolites 20 years previously were easily recognizable, and future collectors should have no difficulty in picking out our spoil heaps for many years to come. Dr. T. S. Hall reported on the collection made by Mr. Baragwanath, and identified many old species or described some new ones.*

The specimens are all in the collection of the Geological Survey of Victoria.

Identifications.

Locality 1.—

Diplograptus sp. with virgula well shown (abundant).
Climacograptus sp.
Dicellograptus elegans Carr. (rather rare).

Locality 2.—

Diplograptus calcaratus Lapw., var. vulgatus Lapw. 23937.
Dicellograptus elegans Carr. 23936 (very common).
Leptograptus flaccidus J. Hall. 23938.

Locality 3.—

Diplograptus quadrimucronatus J. Hall. 23947, 23941 (reverse of 23947), 23950, 23951.
Diplograptus carnei T. S. Hall. 23942, 23947, 23941, 23946.
Diplograptus truncatus Lapw., var. intermedius Elles & W. 23947, 23941, 23942, 23946, 23950.
Diplograptus sp. indet. 23939, 23943, 23944, 23952.
Climacograptus sp. 23943.
Dicellograptus elegans Carr. 23940, 23942, 23943 (Pl. 71, Fig. 3), 23945, 23946.
Dicellograptus (?) pumilus Lapw. 23944.
Dicellograptus sp. 23941, 23947, 23949.
Leptograptus flaccidus J. Hall, var. subjectus, nov. 23951.

Locality 4.—

Diplograptus quadrimucronatus J. Hall. 23953, 23955, 23966, 23968, 23969, 23974 (reverse of 23969), 23972, 23975, 23976. 23982, 23985, 23981 (reverse of 23972).
Diplograptus carnei T. S. Hall. 23969, 23974.
Diplograptus truncatus Lapw. 23982.
Diplograptus truncatus var. intermedius Elles & W. 23957, 23962, 23966, 23969, 23974, 23975, 23977. 23978, 23980, 23988.
Diplograptus sp. 23954, 23957, 23961, 23976.

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* Hall, T. S. Reports on Graptolites, Rec. Geol. Surv. Vict., vol. I,, pt. 4, pp. 268-9, 273–8, Pl. XXXIV.

IDENTIFICATIONS—*continued.*

Locality 4—*continued.*

Climacograptus tubuliferus Lapw. 23967, 23972, 23973.

Climacograptus sp. nov. 23966, 23982.

Climacograptus bicornis J. Hall. 23966, 23968.

Climacograptus missilis sp. nov. (Fig. 144). 23956, 23960 (co-type), 23971 (type).

Climacograptus sp. 23970, 23972, 23981.

Dicellograptus elegans Carr. 23970, 23973, 23978, 23979, 23985.

Dicellograptus affinis T. S. Hall. (Fig. 148), pl. 71, Fig. la-lg). 23958, 23959, 23976, 23964, 23978, 23984, 23985, 23987, 23988.

Dicellograptus (?) pumilus Lapw. 23959, 23969, 23974, 23977, 23988.

Dicellograptus (?) complanatus Lapw., var. ornatus Elles & W. 23978, 23979, 23985, 23987.

Leptograptus flaccidus J. Hall. 23964, 23968, 23969, 23974, 23967, 23973, 23976, 23982, 23983.

Leptograptus flaccidus var. subjectus, nov. (Fig. 146). 23958, 23960, 23966, 23967, 23984, 23987, 23973 (type).

Leptograptus eastonensis, sp. nov. (Fig. 147, Pl. 70, Fig. la-d). 23954, 23963, 23964, 23975, 23976, 23977, 23980, 23969 (co-type), 23974 (part reverse of 23969) (type).

Leptograptus capillaris Carr. 23964 (Pl. 70, Fig. 2a).

Dicronagraptus furcatus J. Hall. 23967, 23969, 23974, 23976, 23973.

Locality 5.—

Diplograptus and Dicellograptus in highly cleaved blue-black shales.

Locality 6.—

Diplograptus ingens T. S. Hall. 23989 (?), 23990 (?).

Climacograptus tubuliferus Lapw. 23991.

Climacograptus sp. 23993.

Dicranograptus nicholsoni Hopk. 23991, 23993, 23994.

Dicranograptus hians T. S. Hall. 23989, 23992.

Cryptograptus tricornis Carr. 23991, 23992.

In the collection from this locality—a rather small one—Dicellograptus was not found.

Locality 7.—

Dicellograptus shales.

Locality 8.—

Dicellograptus shales.

IDENTIFICATIONS—*continued*.

Locality 9.—

Diplograptus quadrimucronatus J. Hall. 23999.
Climacograptus bicornis J. Hall. 23996, 23998, 23999.
Dicellograptus elegans Carr. 23995.
Leptograptus flaccidus J. Hall. 23998, 23999.
Leptograptus flaccidus var. subjectus nov. 23997.
Leptograptus eastonensis sp. nov. 23995.
Dicellograptus seemed rather rare at this outcrop.

Locality 10.—

Diplograptus quadrimucronatus J. Hall. 24000, 24073.
Dicellograptus sp. 24000, 24001, 24002, 24003 (a distinct species, but with insufficient detail for identification).
Climacograptus bicornis J. Hall. 24002.
Dicellograptus gravis, sp. nov. (Pl. 71, Figs. 2a, 2b). 24004 (type), 24085 (cotype).
Dicellograptus (?) complanatus Lapw., var. ornatus Elles & W. 24000.

Locality 11.—

Climacograptus exiguus, sp. nov. (Fig. 145). 24005, 24006 (type), 24007A, 24007B (very common in earthy blue-black slate).

Locality 12.—

Climacograptus bicornis J. Hall. 24008, 24009, 24010 (near junction with the Silurian).

Locality 13.—

Diplograptus truncatus Lapw., var. intermedius Elles & W. 24014.
Diplograptus sp. 24011, 24012, 24017, 23948.
Climacograptus wellingtonensis T. S. Hall. 24013, 24015 (reverse of 24013).
Diconograptus nicholsoni Hopk. 24011, 24016, 24018 (reverse of 24016).

Localities 14 and 15.—

Not represented in collection.

Locality 16.—

Diplograptus calcaratus Lapw. 24020, 24021, 24022, 24023.
Diplograptus sp. indet. 24025.
Climacograptus mensoris T. S. Hall. 24024.

Locality 17.—

Diplograptus, sp. indet. 24026, 24027 (reverse of 24026), 24028.

IDENTIFICATIONS—*continued*.

Locality 18.—

Diplograptus quadrimucronatus J. Hall. 24031, 24038.
Diplograptus carnei T. S. Hall. 24030, 24035.
Diplograptus (?) carnei. 24052, 24053, 24054.
Diplograptus sp. indet. 24033, 24035, 24044, 24045, 24048.
Climacograptus bicornis J. Hall. 24037, 24040, 24046, 24050, 24055, 24056.
Climacograptus bicornis var. peltifer. 24032.
Leptograptus flaccidus J. Hall. 24042
Cryptograptus tricornis Carr. 24029, 24036, 24057 (reverse of 24036), 24034, 24039, 24041, 24043, 24049.
(?)Retiograptus speciosus Harris. 24047.

Locality C.—

Diplograptus quadrimucronatus J. Hall. 24064, 24073.
Diplograptus truncatus Lapw., var. intermedius Elles & W. 24075.
Diplograptus sp. indet. 24060, 24062, 24065, 24077.
Climacograptus tubuliferus Lapw. 24066.
Climacograptus sp. indet. 24063, 24077.
Dicranograptus hians T. S. Hall. 24067, 24076 (reverse of 24067).
Dicranograptus ramosus J. Hall, var. semi-spinifer T. S. Hall. 24061.
Dicranograptus ramosus. 24067, 24076, 24072.

Locality D.—

Diplograptus shales. 24074.

Locality F.—

Climacograptus bicornis J. Hall, var. tridentatus Lapw. 24079.

Locality G.—

Diplograptus quadrimucronatus J. Hall. 24081, 24082.
Diplograptus truncatus Lapw., var. intermedius Elles & W. 24083.
Dicellograptus elegans Carr. 24081, 24082.
Dicellograptus (?) pumilus Lapw. 24082.

Locality east of and close to Locality A.

Diplograptus, Climacograptus, Dicellograptus, and Leptograptus.

Silurian, north of Locality A.

Monograptus (2 specimens). 24058, 24059 (reverse of 24058).

North end of spur, at beginning of rise to Silurian—

Dicellograptus elegans Carr. 24084.
Climacograptus sp. 24084.

Correlation with British and North American Upper Ordovician Zones.

After the specimens from Mt. Easton had been identified, the results were compared with British[1] and North American[2] records of Upper Ordovician graptolites. The collection from Locality 4, Mt. Easton, has been selected for this purpose owing to the relative completeness of the collection and the excellent preservation of the fossils. The table below shows this comparison:—

	Upper Ordovician Strata.								
	Victoria.	Britain.					North America.		
		Upper Glenkiln.		Lower Hartfell.					
	1.	2.	3.	4.	5.	6.	7.	8.	9.
Diplogr. quadrimucronatus ..	×	..	..	..	..	×	..	..	×
D. truncatus	×	..	..	..	×	×	..	..	..
D. truncatus var. intermedius ..	×	..	..	×	×	..	..	×	..
Climacogr. tubuliferus ..	×	..	..	..	×	×	..	..	..
C. bicornis	×	×	×	×	×	..	×	..	×
Dicellogr. elegans	×	..	..	..	×	×	..	..	..
D. pumilus	×	..	..	..	×	×	..	..	..
Dicranogr. furcatus	×	..	..	..	..	..	×	..	..
Leptogr. flaccidus	×	..	..	..	×	×	..	..	..
L. capillaris	×	..	..	..	×	×	..	..	..

1. Locality 4, Mt. Easton.
2. Zone of Nemagraptus gracillis.
3. Zone of Climacograptus peltifer and Mesograptus multidens.
4. Zone of Climacograptus wilsoni.
5. Zone of Dicranograptus clingani.
6. Zone of Pleurograptus linearis.
7. Normanskill shale.
8. Magog.
9. Utica shale.

British forms not found in the Mt. Easton beds include Pleurograptus and Amphigraptus. Notable British forms from other Mt. Easton localities are Dicranograptus ramosus and D. nicholsoni (both Upper Glenkiln and Lower Hartfell), and Diplograptus calcaratus (Lower Hartfell). As regards the British forms, the comparison is striking, and it may be stated with some confidence that Locality 4 at Mt. Easton corresponds with either the zone of Dicranograptus clingani or the zone of Pleurograptus linearis, more probably with the former. Both these zones are in the Lower Hartfell shales, which occupy a position a little above the middle of the Upper Ordovician formation.

(1) Elles, Gertrude L., and Woods, Ethel M. R. Pal. Soc., Vol. LXVII., British Grapt., Pt. X, The Zonal Distribution of the British Graptoloidea, p. 516.

(2) Ruedeman R. Grapts. of N. York. pt 2, N. Y. State Mus. Rept., Mem. 11, pp. 61-3. Synoptic Table of the Distribution of the Gra ts. of the Upper & Middle Champlainic (Ordovicic) of the U.S.A., pp. 48-51.

Descriptions of Species.

Climacograptus Missilis sp. nov. Fig. 144.

Rhabdosome short, not exceeding 1.5 cm. in observed specimens, narrow at origin and increasing constantly in width throughout to 2.0 mm. Virgella short. Virgula visible in the body of the rhabdosome, free at the distal end for 6 mm. or more, and in some cases expanded into a small irregularly shaped vesicle at its apical extremity. Sicula visible for 0.6 mm. of its length. Thecae 10-14 in 10 mm., proximally sigmoidal, distally slightly curved, overlapping $\frac{1}{3}$-$\frac{1}{2}$; apertural margin undulate, lying within excavations which occupy about one-quarter of the width of the rhabdosome.

Remarks.—In the biprofile view the proximal thecae are of the typical Climacograptus type, the excavation is conspicuous, and the sigmoidal curvature of the ventral wall pronounced; distally, however, the excavations become less conspicuous and the ventral walls almost straight.

Explanation of Fig. 144.—

(*a*) Reverse biprofile aspect showing typical Climacograptus thecae at proximal end. Type No. 23971, Loc. 4.

(*b*) Sub-scalariform view. No. 23971 (3), Loc. 4.

(*c*) Small specimen showing virgella. No. 23991 (2), Loc. 4.

(*d*) Sub-scalariform view. Cotype. No. 23960, Loc. 4.

Fig. 144. *Climacograptus missilis.* ×4.

Associates.—*Diplograptus quadrimucronatus, D. carnei, D. truncatus,* var. *intermedius, Climacograptus tubuliferus, C. bicornis, Dicellograptus elegans, D. affinis, Leptograptus flaccidus, L. castonensis, Dicranograptus furcatus.*

Climacograptus exiguus sp. nov. Fig. 145.

Rhabdosome short, less than 8 mm. in length, increasing in width to 1.1 mm. within 2 mm. of sicula and thence parallel-sided; rounded at proximal end. Sicula visible for less than 0.5 mm. Virgella inconspicuous. Thecae 17-20 in 10 mm. Basal thecae adorned with spines; free edge straight and vertical; apertural margin slightly introverted lying within excavations which occupy $\frac{1}{2}$-$\frac{1}{3}$ width of rhabdosome.

Affinities.—*C. exiguus* bears most resemblance to *C. putillus* J. Hall, mut. *eximius* Rued.,* from which, however, it differs in the constant width of the parallel free edges, its somewhat greater width, and its slightly closer arrangement of the thecae.

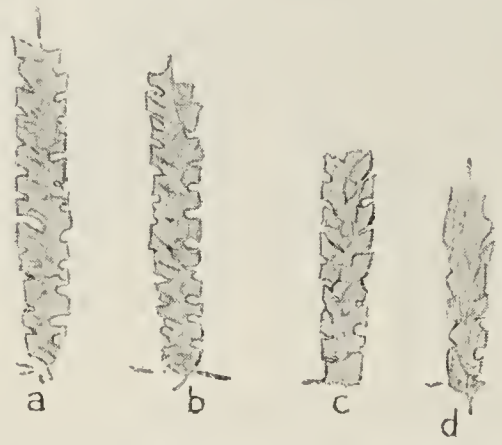


Fig. 145. *Climacograptus exiguus.* ×4.

Explanation of Fig. 145.—

(*a*) Reverse view. Type No. 24006, Loc. 11.
(*b*) Specimen showing virgella and basal spines. No. 24007A, Loc. 11.
(*c*) Specimen showing virgella and basal spines. No. 24007B (1), Loc. 11.
(*d*) Obverse view. Cotype No. 24007B (2), Loc. 11.

Leptograptus flaccidus J. Hall, var. *subjectus,* nov. Fig. 146.

A Leptograptus occurs at Mt. Easton which resembles *L. flaccidus* in all except the character of the proximal region. The initial angle of divergence of the stipes is less than 180°, and they then become suddenly reflexed. We have separated this form as *L. flaccidus* J. Hall, var. *subjectus* nov., for convenience of reference.

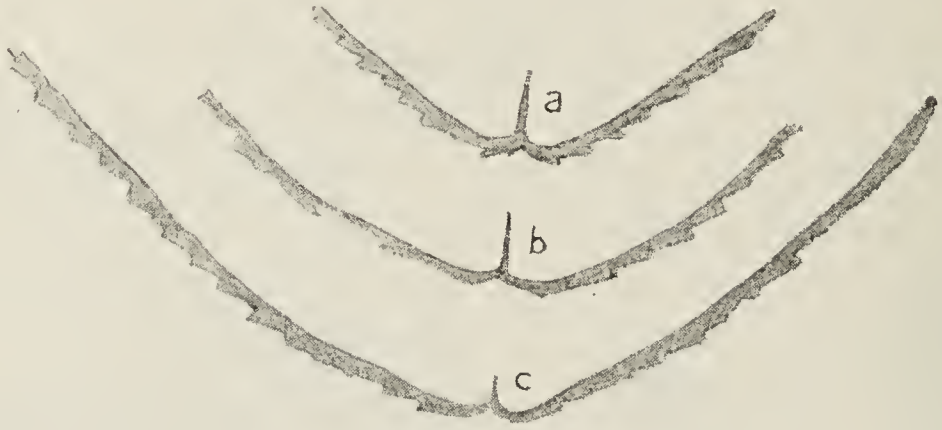


Fig. 146. *Leptograptus flaccidus* var. *subjectus.* × 4.

Explanation of Fig. 146.—

(*a*) Typical view. Type No. 23973 (3), Loc. 4.
(*b*) Typical view. Cotype. No. 23960, Loc. 4.
(*c*) Typical view. No. 23973 (3), Loc. 4.

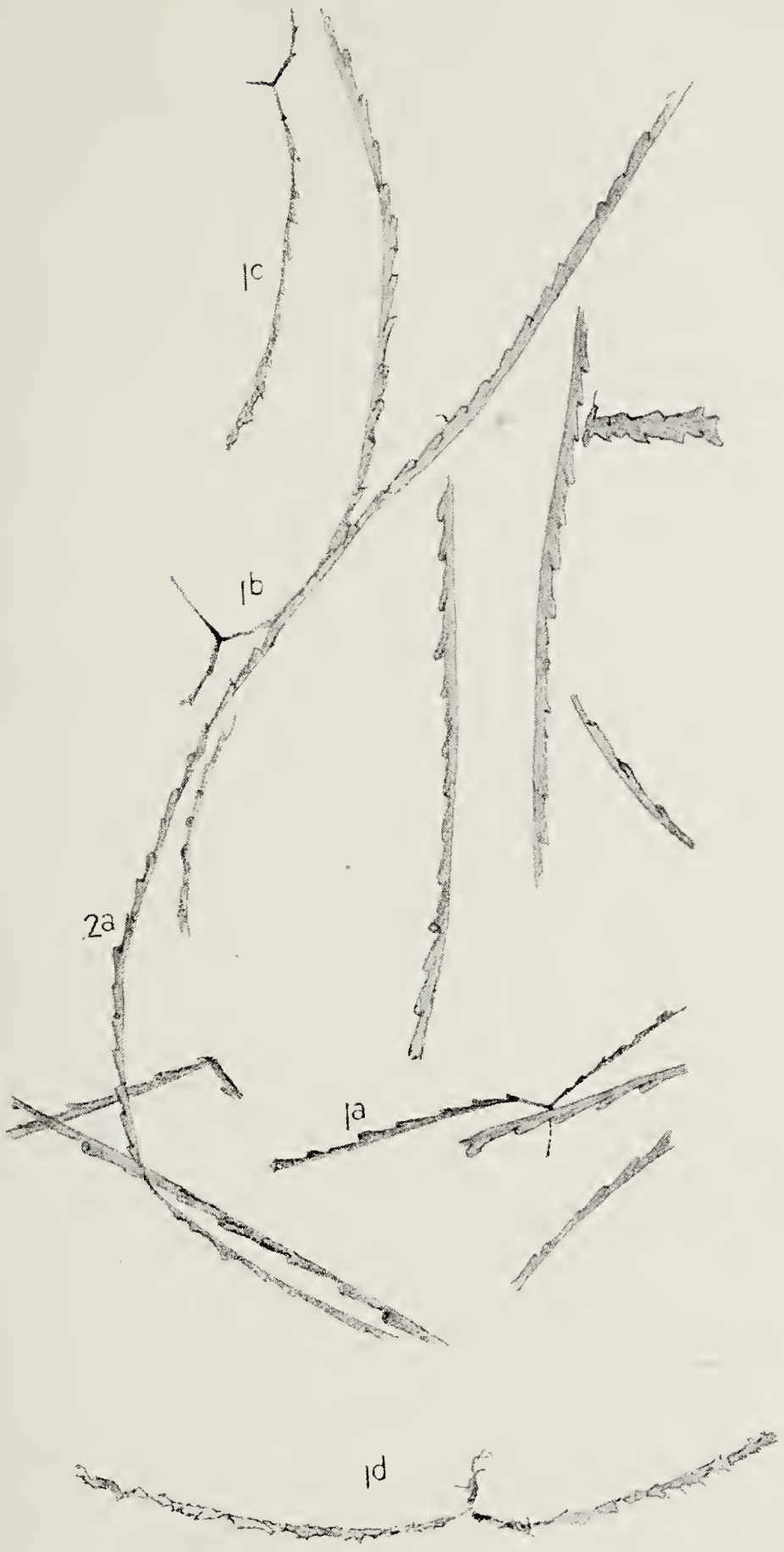
Leptograptus eastonensis, sp. nov. Fig. 147 and Pl. 69, Fig. 1 (*a*)-1 (*d*).

Stipes narrow (maximum width under 0.4 mm.), flexed, several centimetres in length, widening gradually and almost imperceptibly, but always conspicuously narrow. Sicula 2 mm. in length. Thecae uniformly narrow, 10-11 in 10 mm., inclined at a very low angle, six times as long as broad in the proximal thecae, but about four times distally, overlap slight, mucronate. Apertural margin narrow, slightly introverted.

Remarks.—The dorso-lateral aspect (Pl. 69, Fig. 1 (*d*) of the rhabdosome shows that the thecae are mucronate for a considerable distance from the sicula. This species resembles *Leptograptus flaccidus,* var. *macer* more closely than any other Leptograptus with which we are acquainted. It has the same long tapering sicula and tenuity of stipes, but the appearance of the proximal region is different. The initial

* Ruedemann, R. Grap. of N. York, pt. 2, N. Y. State Mus. Rep., Mem. 11, 61-3, p. 420 and fig.

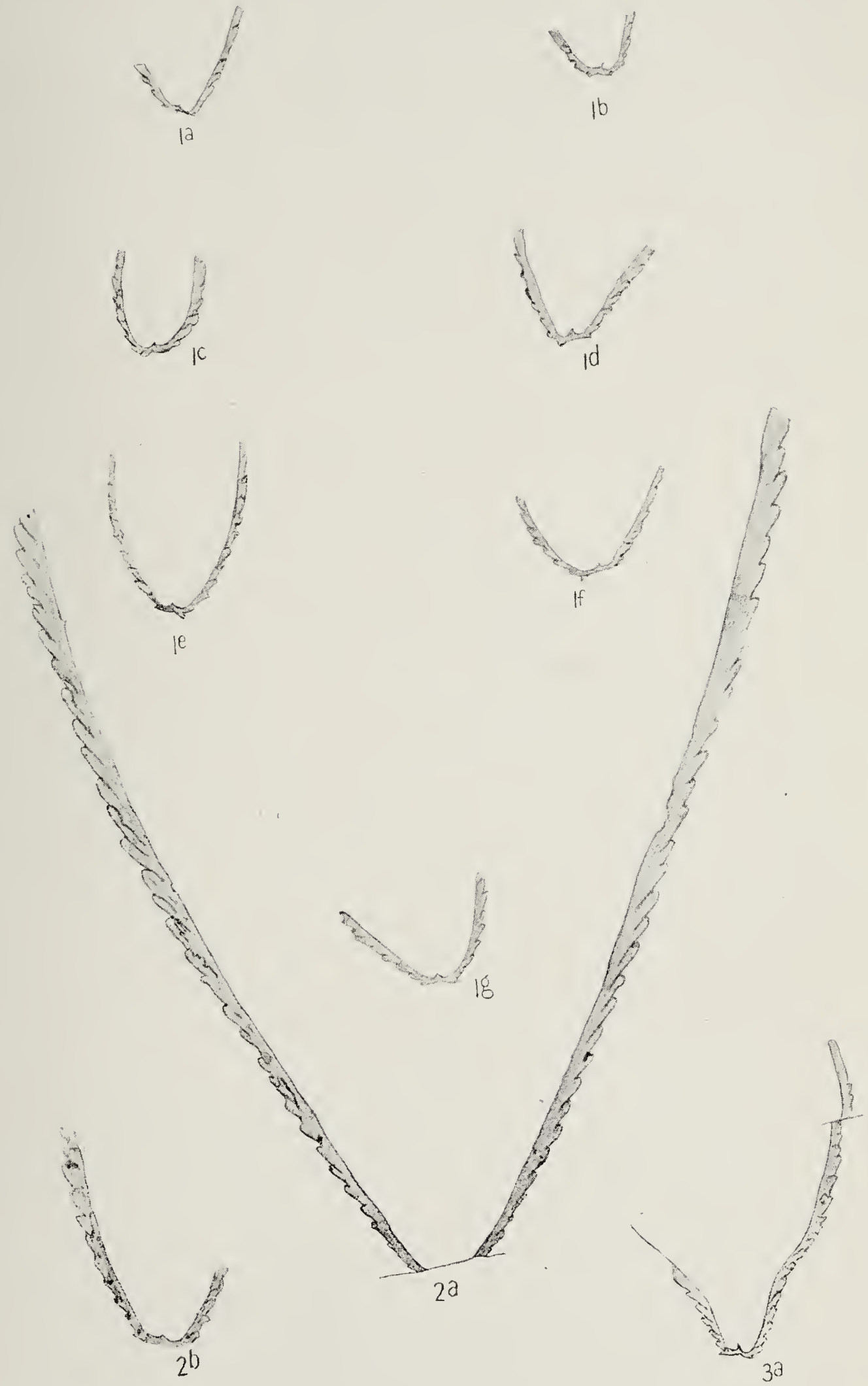
PLATE 69.



W. H. and R. A. K. del.

Leptograptus.

Plate 71.



W. H. and R. A. K. del.

Dicellograptus.

angle of divergence of the thecae from the sicula seems constantly to be within a few degrees of 130°. This angle is characteristic, but the stipes soon bend round sufficiently to give the rhabdosome the form of the conventional "flying bird" symbol. The thecae are also slightly more closely arranged than in *L. flaccidus,* var. *macer.*

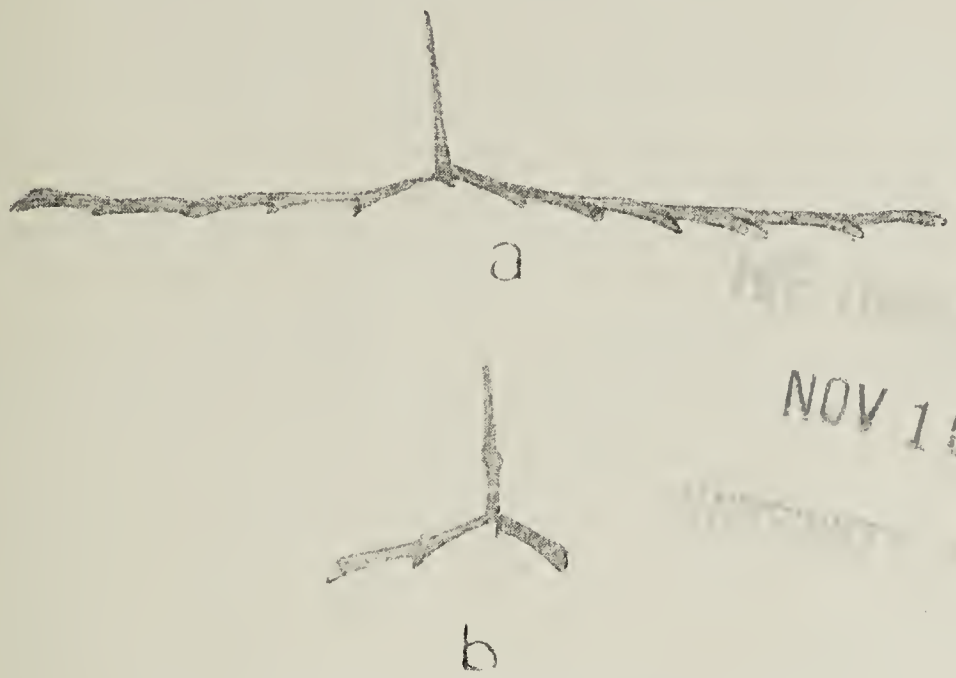


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Fig. 147. *Leptograptus eastonensis.* × 8.

Explanation of Fig. 147 and Pl. 69.—

Fig. 146 (*a*). Type No. 23974, Loc. 4.
Fig. 146 (*b*). Proximal obverse view. No. 23963, Loc. 4.
Fig. 69, Fig. 1 (*a*). Typical form. No. 23964, Loc. 4.
Pl. 69, Fig. 1 (*b*). Typical form. Same slab.
Pl. 69, Fig. 1 (*c*). Typical form. Same slab.
Pl. 69, Fig. 1 (*d*). Dorse-lateral aspect, showing mucronate thecae. Cotype. No. 23969, Loc. 4.

Associates.—*Leptograptus eastonensis* is associated at Mt. Easton with *Leptograptus flaccidus, Dicellograptus elegans,* and *Diplograpti* and *Climacograpti* as shown in the locality list.

Dicellograptus affinis T. S. Hall. Fig. 148 and Pl. 71, Fig. 1 (*a*)-1 (*g*).
1902, Hall, T S., Grapts. of N.S.W., Rec. Geol. Surv. N.S.W., Vol. VII., Pt. 2, p. 2, Pl. XII., XIII.

Fig. 148. *Dicellograptus affinis.* T. S. Hall. × 8.

Explanation of Fig. 148 and Pl. 70, Figs. (*a*)-1 (*g*).—

Fig. 147. Reverse view, showing axil and sicula. No. 23959 (2), Loc. 4.
Pl. 70, Fig. 1 (*a*). Rhabdosome. No. 23987, Loc. 4.
Pl. 70, Fig. 1 (*b*). Rhabdosome. No. 23987, Loc. 4.
Pl. 70, Fig. 1 (*c*). Rhabdosome. No. 23988, Loc. 4.
Pl. 70, Fig. 1 (*d*). Rhabdosome. No. 23964 (3), Loc. 4.
Pl. 70, Fig. 1 (*e*). Rhabdosome. No. 23959, Loc. 4.
Pl. 70, Fig. 1 (*f*). Rhabdosome. No. 23987, Loc. 4.
Pl. 70, Fig. 1 (*g*). Rhabdosome. No. 23964 (2), Loc. 4.

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Stipes usually less than 1 cm. in length, narrow, widening gradually to a maximum width of about 0.6 mm., diverging from a square axil of about 300°-305°. Sicula short and broad. Thecae 10-12 in 10 mm., overlapping half their length, free portion of outer walls slightly curved, apertural margins slightly introverted.

Dicellograptus gravis, sp. nov. Pl. 70, *Figs.* 2*a*, 2*b*.

Stipes 4 cm. or more in length, gently curved, diverging from the sicula (unfortunately indistinct in the specimens before us) at an angle of 180°, but soon turning back so that they enclose an angle of 65°-70°, the angle being apparently determined in some measure at least by the weight of the distal portions of the stipes. The stipes widen gradually from 0.5 mm. near the sicula to rather more than 1 mm. at a distance of 2 cm. and 1.4 mm. at a distance of 4.5 cm. Thecae 8-9 in 10 mm. in the proximal portions of the rhabdosome, but only 6-8 distal thecae in the same space. Overlap of thecae about $\frac{1}{2}$, ventral walls with a slight sigmoidal curve, best shown in the proximal thecae. Apertures introverted.

Explanation of Figures.—

Pl. 70, Fig. 2 (*a*). Incomplete specimen showing heaviness of stipes. Type No. 24004, Loc. 10.

Pl. 70, Fig. 2 (*b*). Specimen more complete proximally. Cotype. No. 24085, Loc. 10.

Remarks.—This species is characterized by a general heaviness of form, and seems distinct from any Dicellograptus figured from Britain or North America. It has the square axil of *Dicellograptus elegans* in an even more pronounced manner, but is a much stouter form. The description is drawn up from two specimens which were found in dark-blue slate, which yielded few other forms determinable specifically. *Climacograptus bicornis* J. Hall and *Diplograptus* spp. were found in it, but no other Dicranograptidæ.

Associates.—*Diplograptus quadrimucronatus, Climacograptus bicornis.*

Dicellograptus elegans Carruthers sp. Pl. 70, Fig. 3 (*a*).

We have recorded and figured as *Dicellograptus elegans* a number of specimens which, in our opinion, are specifically identical with those recorded by Dr. T. S. Hall.[1] It will be noticed, however, that the eminently characteristic double curvature shown by Elles & Wood[2] is much less pronounced in our specimens than in those from English localities, while, on the other hand, the square axil is even more pronounced.

Explanation of Figures.—

Pl. 70, Fig. 3 (*a*).—*Dicellograptus elegans* Carr. Form with less pronounced double curvature and more nearly square axil than Carruthers's type. No. 23943, Loc. 3.

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(1) Hall, T. S. Proc. Roy. Soc. Vict., Vol. XVIII (n.s.), Pl. 1, p, 23, Pi VI., fig. 5 (1905), and Reports on Graptolites. Rec. Geol. Surv. Vict., Vol. I., Pt. 4, p. 275, Pl. XXXIV., fig. 2 (1906).

(2) Elles, Gertrude L., and Wood, Ethel M. R. Pal. Soc., Vol. LVIII., British Grap. Pt. IV., pp. 159-160, figs. 100a, 100b, Pl. XXXIII., figs. 2a, 2c, (1904).

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